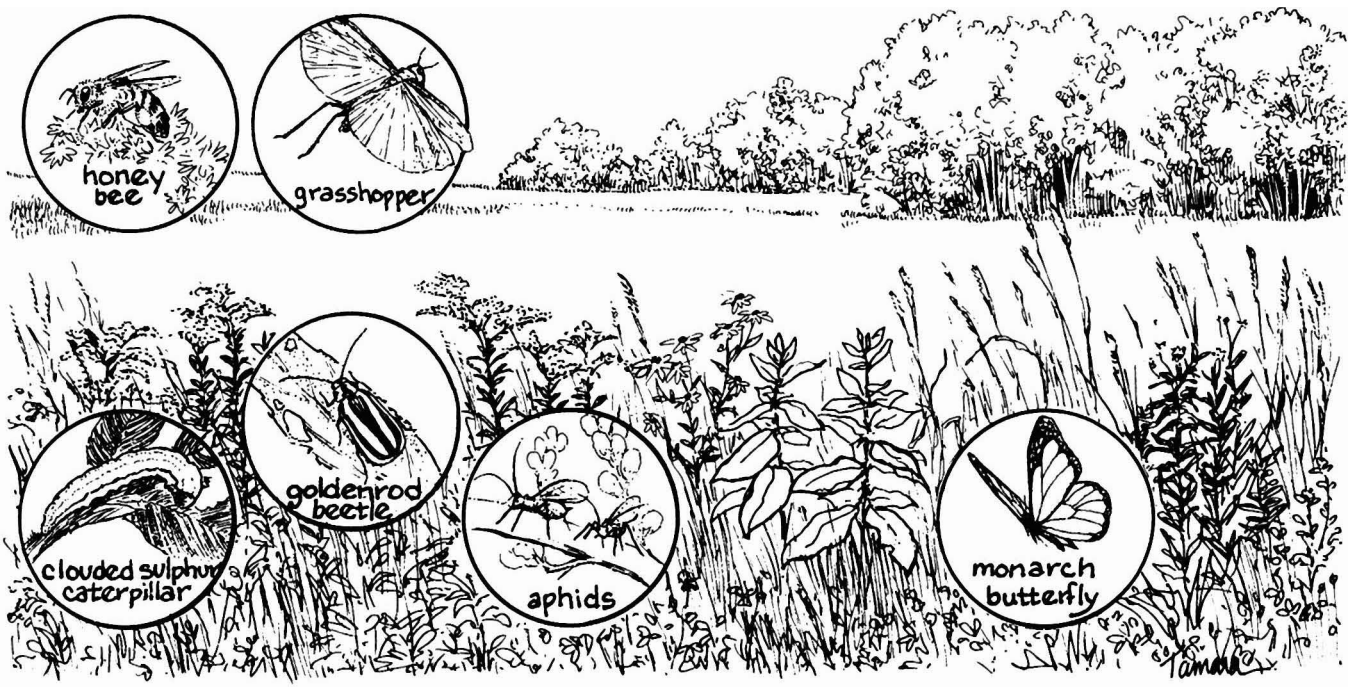
EXPERIENCE

4-H NATURAL RESOURCES

Insects All around Us

Marianne E. Krasny
and
Gregory Neal



4-H Leader's Guide 147-L-23
A Cornell Cooperative Extension Publication

Contents

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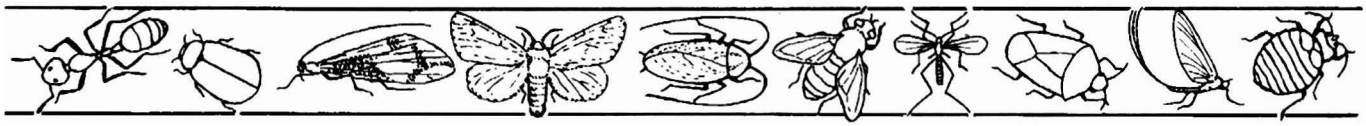
Helping You Put Knowledge to Work



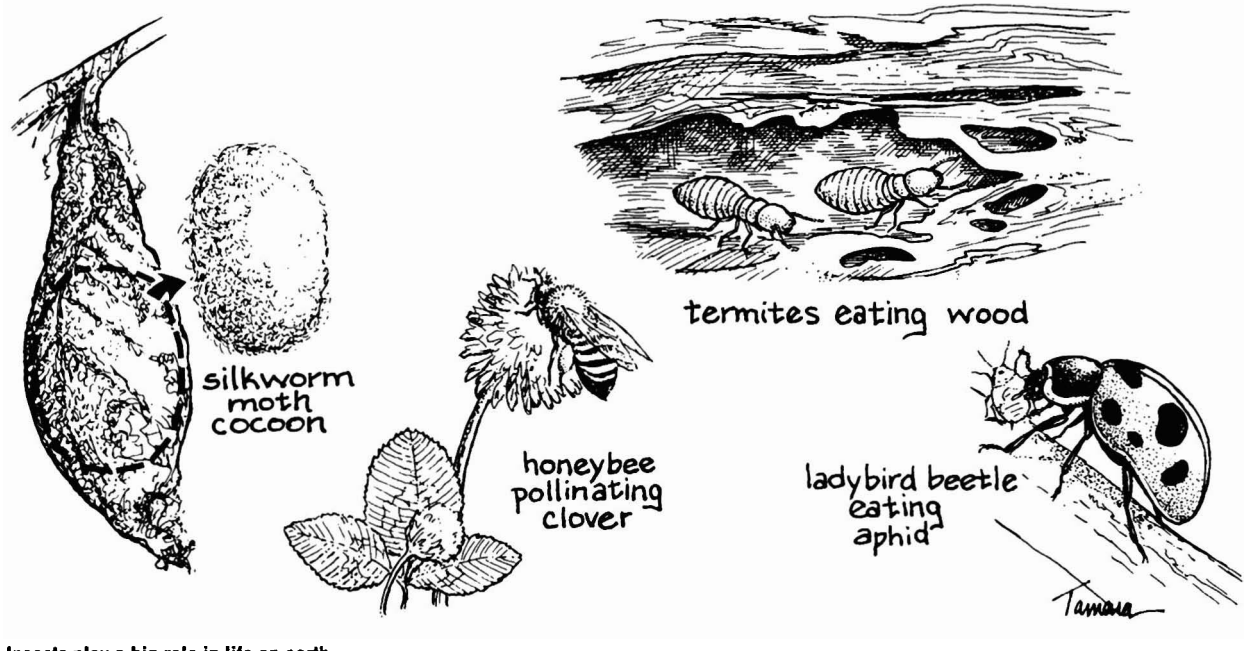
Introduction

Background

Did you know that of all the animals in the world, three-fourths are insects? About one million different species of insects have been described and several thousand new ones are found each year. With numbers like this, it is not surprising that insects play a big role in life on earth, and many are of great importance to humans.

For example, aquatic insects are an essential link in many food chains. They are food for fish, which in turn are eaten by humans. Bees and many other insects are important pollinators of food crops. Some insects also are important for recycling organic wastes—they help break down leaves, garbage, and other organic materials into soil that can be used again by plants. The larva of the silkworm moth provides silk for making clothing. Ladybird beetles prey on many insect pests that damage important plants. Some insects are important because of the harm they do. The clothes moth eats our wool clothing. The flour beetle is an important pest of stored grains.

There is hardly a place on earth where you cannot find insects. A powderpost beetle can survive for ten years in the leg of a table, getting water from the wood it consumes. Some members of the group of insects called rock crawlers carry out their life cycle on glaciers in mountains of the western United States. The German and American cockroaches are close relatives of rock crawlers, yet they prefer an altogether different existence, residing in houses in close association with humans. The Cynthia moth also prefers to live close to humans; it is found in railroad yards and abandoned warehouses in cities where its host plant, ailanthus, thrives. Some water striders even live on the surface of the ocean, often many miles from land. No matter where you live, play, or travel, you can observe insects and learn from them.



Insects play a big role in life on earth.

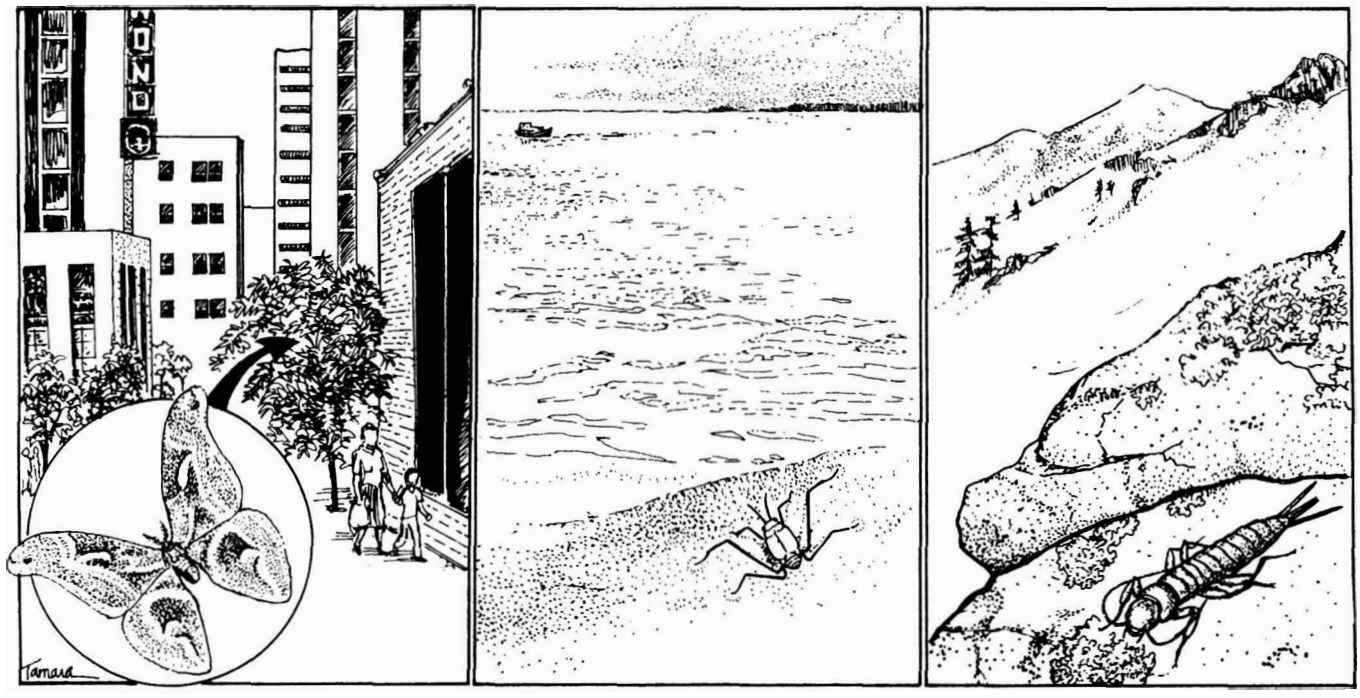
Learning about insects can be fun as well as fascinating. Some youths in your group may think insects are "gross" or "creepy." They may feel that way because someone else influenced them. And that person was probably influenced by someone else. There are few reasons, however, for disliking insects. The vast majority (over 99 percent) are not harmful to humans.

In this project, you will help youths learn about several aspects of insect life. First, you and your group will find out what makes an insect different from other animals. Next your group will learn about the many different kinds (diversity) of insects by building and using sampling equipment. Then they will learn about insect behavior by observing insects at close range. Finally, your group will have an opportunity to integrate what they have learned by playing an insect trivia game. Several references are included at the end of this publication for those who wish to learn more about insects.

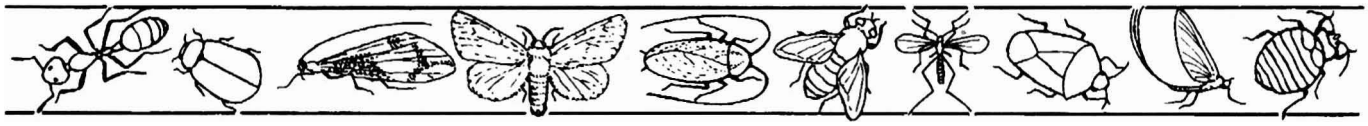
Safety

Several of the activities in this guide involve collecting insects. Find out beforehand if any members of your group develop severe reactions to insect stings or bites, then limit the activities of those individuals.

Instruct the youths in your group to avoid stinging insects such as bees and wasps if at all possible. If a stinging insect is caught in a net or other sampling device, make sure the youths remain calm as they let it go. Also, be sure to have the youths avoid areas known to have ticks. Always have them check for ticks after being outside.



Insects live in many different and extreme habitats.



Getting Started

This project is designed for youth group leaders, camp counselors, teachers, and parents with little or no background in the study of insects (entomology). Reading the short introductory sections to each activity will be enough to prepare you to help your group learn the basic principles of insect life.

The activities in this guide are suitable for youths 9 to 12 years old. Each activity can be accomplished in 45 minutes to an hour, although you may want to stretch out certain activities for a longer time. The activities follow a logical sequence, starting with the most basic. You do not need to conduct all the activities, however, to provide a meaningful experience for youth.

Each activity begins with a short introduction that gives background information and the important concepts covered. Use the list of materials and step-by-step instructions to help you conduct the activity. Don't be afraid, however, to stray from the lesson plan. Let your group—and the insects—lead you.

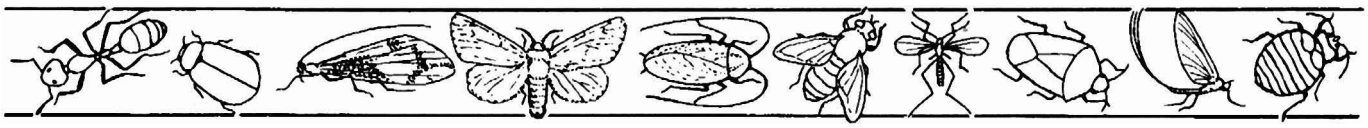
Encouraging Learning

If a member of your group asks you a question you can't answer, don't be afraid to say, "I don't know." Try to think of ways you can guide the youngster to find his or her own answer. Follow the example of a teacher of the great naturalist Liberty Hyde Bailey. Upon becoming aware of young Bailey's interest in nature study, the teacher admitted she knew little about science but suggested they learn together. She asked him how many trees grew along his route to school, so he counted them. Then she asked what kinds of trees they were, and he set off to find out. With his teacher's guidance, Bailey began what was to be a lifelong exploration of natural science, despite (or perhaps because of) his teacher's professed ignorance.

The activities in this guide give an enjoyable, active introduction to the study of insects. Your goal is not to train young entomologists. Rather, if you can get some of the youngsters in your group to appreciate insects for being unique and for having an important role in the natural world, you will have accomplished an important first step. Consider the project a success if the youths are interested enough to want to learn more on their own.

If you are lucky enough to have a budding entomologist in your group, you may want to suggest that he or she pursue a more advanced 4-H entomology project, such as *Know Your Insects* or *Growing Moths.* Refer youths who want to make an insect collection to a third 4-H publication, *Labelling and Storing an Insect Collection* (see "For Further Information").

Observing insects is educational and fun.



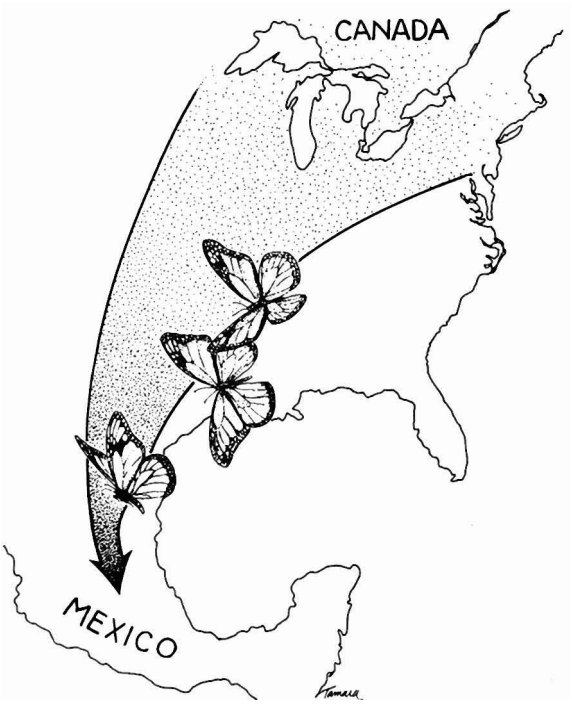
Fascinating Facts about Insects

Olympic Athletes

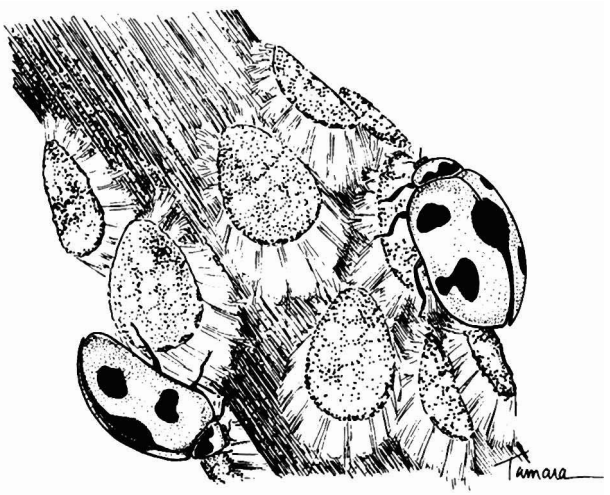
- An ant can pick up a stone fifty times its own weight.
- If you had the jumping ability of a grasshopper, you could jump the length of a football field.
- If you had the hopping ability of a flea, you could bound about four city blocks.
- Dragonflies cruise at about 30 MPH (48 km per hour), whereas house flies have a normal cruising speed of 5 MPH (8 km per hour).
- You have fewer than 800 distinct muscles, but grasshoppers have 900, and some caterpillars have more than 4,000.

Insect Pests

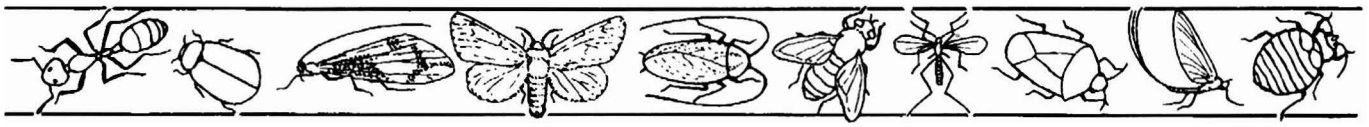
- Of all the insect species, less than 1 percent are considered harmful to humans.
- Some insect pests have been successfully controlled using their natural enemies instead of chemical insecticides. For example, a particular type of ladybird beetle (the vedalia beetle) feeds on a pest of citrus fruit trees called the cottony cushion scale and keeps the scale from becoming a major problem. This method of reducing harmful insect populations is called *biological control.*
- Integrated pest management, or IPM, refers to the use of a variety of strategies to keep insect populations small enough so they do not significantly damage crops. IPM practices include providing plants with proper nutrition, timing the planting of crops, spacing plants properly at planting, using biological controls, and, if needed, using chemical pesticides properly. IPM usually reduces the need for chemicals, but may not eliminate it altogether.
- If we stopped using all pesticides, the loss in world food production would cost about $10 billion each year.

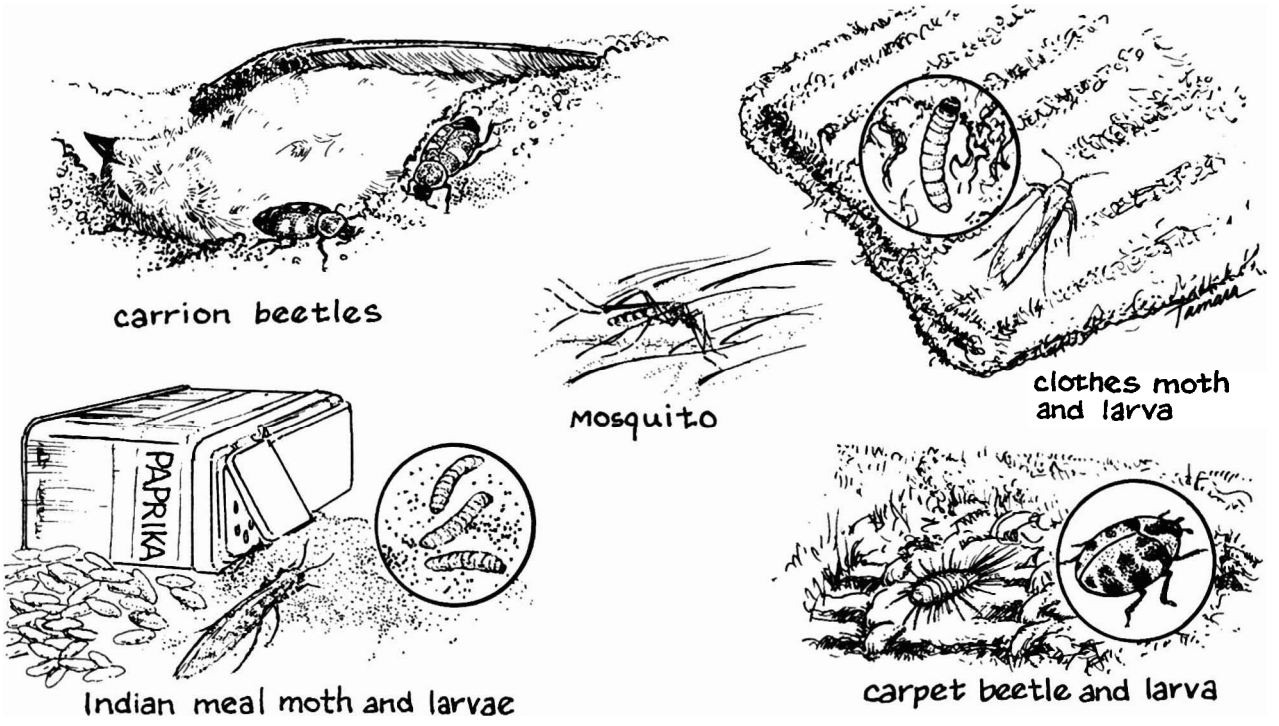


- The longest known flight for a migrating monarch butterfly is 1,870 miles (2,896 kilometers), from Ontario, Canada, to San Luis Potosi, Mexico.



Vedalia beetles feeding on cottony cushion scale





Yum!

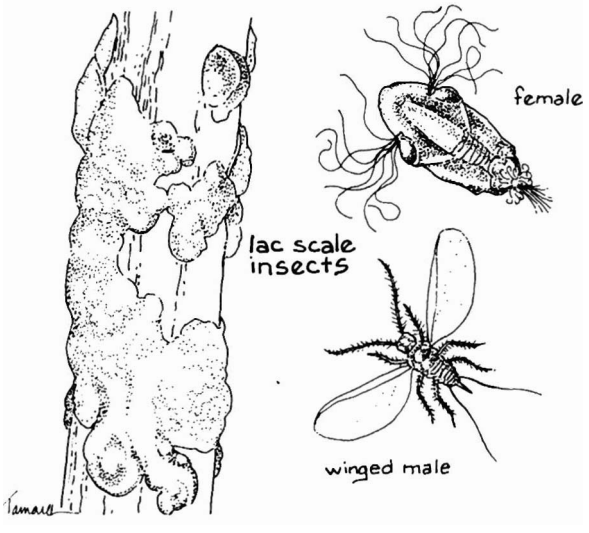
- Insects feed on such things as paprika, clothes, carpets, rotting animals, and blood.
- Immature insects, or larvae, often eat foods entirely different from what adult insects eat. Some adult insects do not feed at all.
- In its first two days of life, the caterpillar of a giant silkworm moth consumes an amount of food equal to 86,000 times its birth weight.
- The endangered Karner blue butterfly feeds on only one plant, the wild blue lupine.

Coat of Armor

- The insect's skeleton is outside rather than inside its body. The hard layer on the outside is called the exoskeleton.

Interesting Insect Products

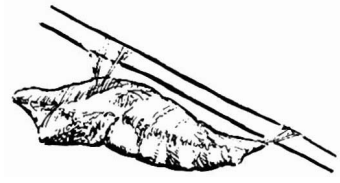
- Shellac is produced from the secretions of an insect called the lac scale.
- The larvae of giant skipper butterflies are considered a delicacy in Mexico. You can buy them in cans in the United States.
- For centuries, military doctors observed that wounds infested by maggots healed better than wounds with no maggots. It was discovered that maggots excrete an antibiotic substance called allantoin, which is now used in treating wounds.

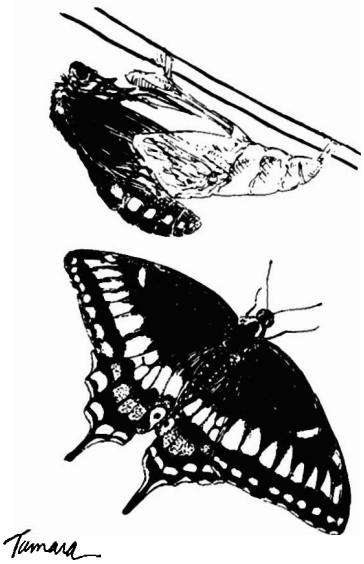


Questions to Stimulate Thought

Abracadabra

- The lowly caterpillar becomes the beautiful butterfly. We take this change for granted, but think about it. It's like a magic trick!





Eastern black swallowtail

Before starting this project, you may want to start your group thinking about insects by asking the following questions. Possible responses are included.

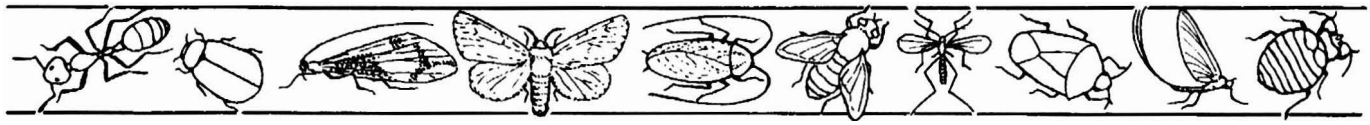
Name five ways insects help you and your family.

- Insects provide honey and beeswax.
- Insects pollinate melons, carrots, squash, strawberries, alfalfa, blueberries, apples, and many other crops. Without insect pollinators, many of these foods wouldn't be available.
- Insects pollinate flowers, whose beauty we enjoy.
- Insects control other harmful insects by eating them.
- Insects help break down dead organic matter and garbage in our garden and compost pile.
- Insects are a source of food for the fish we like to catch and eat.
- Insects are a source of food for the birds we like to watch.
- Insects offer us a way to explore nature.

Why do some people think all insects are "yucky" or "gross?"

- They learned the attitude from someone else.
- They think only about insects that eat garbage, such as cockroaches, or those that bite, such as mosquitoes.

Insects are important pollinators of plants.



Name five ways insects are harmful to people.

- Some insects carry diseases.
- Some insects eat our food crops and stored food.
- Some insects damage the trees we use for shade, recreation, and building materials.
- Some insects damage wooden homes.
- Some insect bites are painful and even dangerous.

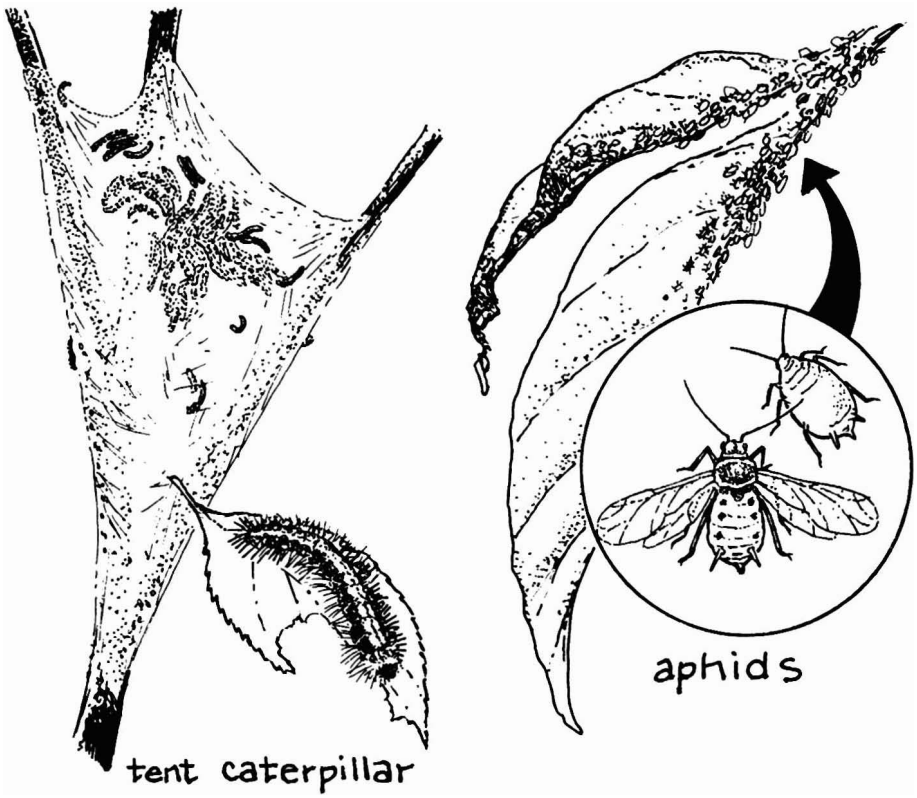
How do humans benefit insects?

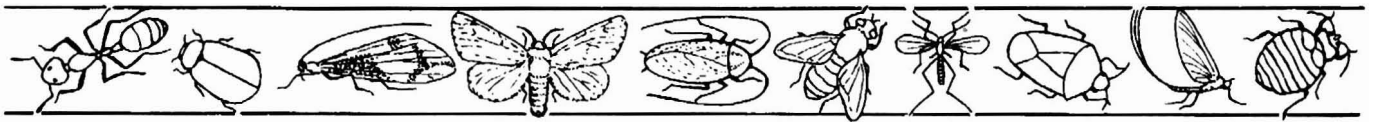
- We provide food for many insects. For example, insects eat our crops, our garbage, and the flowers in our gardens.

How do humans harm insects?

- We kill beneficial as well as harmful insects with insecticides.

  We destroy the places they live (habitat), for example, by building a shopping mall in a forested area or by draining a wetland for farms.



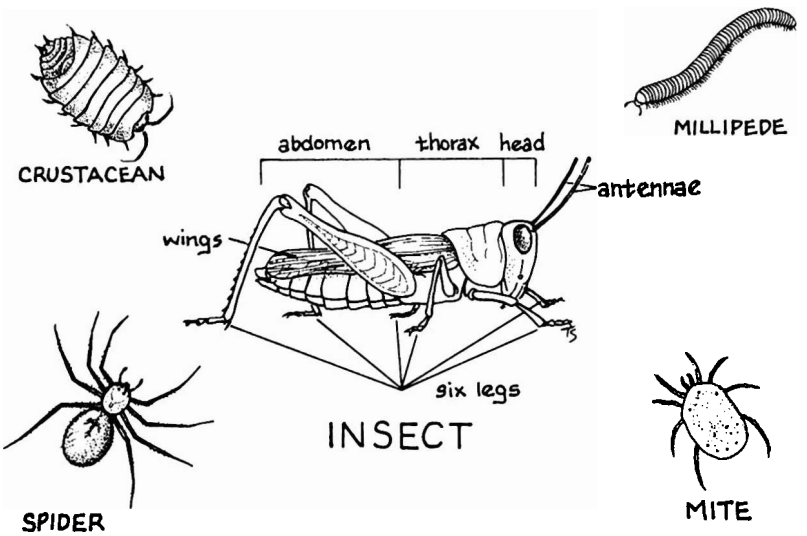


Activity 1: Build a Bug

What makes an insect different from other animals? Adult insects have

- a body with three distinct divisions—head, thorax, and abdomen,

  six legs attached to the thorax,
- one pair of antennae on the head, and
- usually wings (generally two pairs, but sometimes one pair) attached to the thorax.



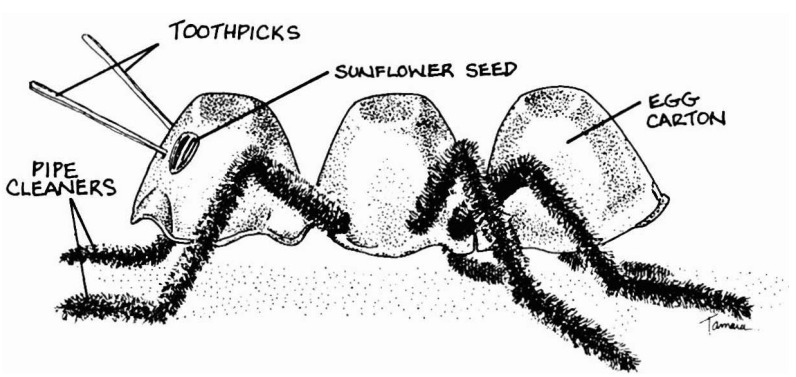
Animals that do not have all these characteristics are not insects, even though they may look like them. For example, spiders, mites, and ticks have only two body divisions (the head and thorax are combined to form a cephalothorax), eight legs, and no antennae. Crustaceans, such as pill bugs, also have only two body segments, but they have antennae and from three to more than seventy pairs of legs. The wormlike bodies of millipedes and centipedes have many segments. Centipedes have two legs (one pair) for each segment, and millipedes have four legs (two pairs) per segment. The total number of legs of centipedes and millipedes ranges from 12 to 200.

What Youth Discover

- All insects have three body parts, six legs, and two antennae.

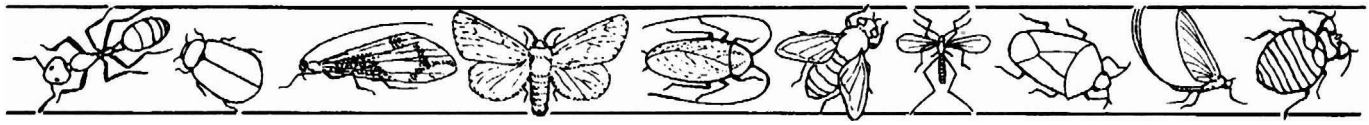
What You Need

- materials gathered from around the house that the youths can use to build their own insects—for example, egg cartons, pipe cleaners, paper, cardboard, dried grass, dried corn husks, sticks, seeds, string, feathers, corks, toothpicks (Be creative!)
- glue
- scissors



What to Do

1. Explain to your group the distinguishing characteristics of insects.
2. Lay out the materials for the youths. Challenge them to construct their own insects. Make sure each insect they create has three body segments, six legs, and two antennae. They can add wings if they want. They may also want to add eyes, mouthparts, and other features.
3. Youths who finish early may want to construct a "non-insect," such as a spider or a centipede.



Activity 2: Collecting Insects

Collecting and observing insects are great ways for the members of your group to discover the variety of insects around them. They will also learn what kinds of insects live in different habitats.

When your group is collecting insects, warn them to stay away from stinging bees and wasps. After they have a chance to observe the insects they collect, they should return all surviving insects to where they found them.

There are several ways to collect insects. The youths in your group can build some of the simple equipment described here, or they can purchase a sampling net from a biological or nature supply company. Four types of insect collecting equipment are included in this activity: pitfall traps, bush beaters, shake-it boxes, and sampling nets. Pitfall traps are used to collect insects crawling along the ground. Bush beaters and shake-it boxes are used to collect insects that are in bushes, usually feeding on leaves. Sampling nets are used to collect insects flying over or living in grass, bushes, and other low-lying vegetation. Building the shake-it box and the sampling net will take extra time.

Once the youths have built or obtained the sampling equipment, they can collect insects. A white sheet of paper and an insect observation box (bug box) or a clear jar are particularly helpful for observing the insects collected.

What Youth Discover

- How to build and use simple insect sampling equipment.

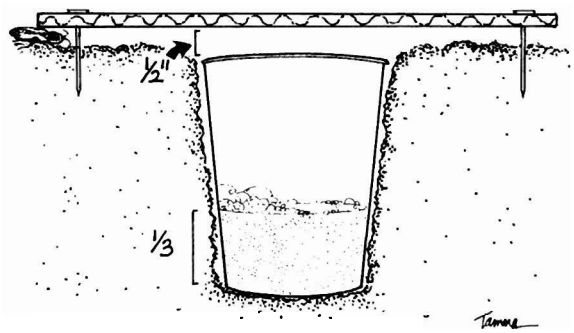
Pitfall Traps

What You Need

- a trowel or bulb planter
- an 8-ounce steep-sided plastic cup or steep-sided can
- soapy water (optional)
- a small piece of plywood or waxed cardboard with a nail in each corner, large enough to cover the cup or can
- a strainer (optional)
- a plastic bag or a jar with a lid
- a white sheet of paper
- forceps (available from a biological supply company) or tweezers (optional)

What to Do

1. Dig a hole the size of the 8-ounce cup or can using the trowel or bulb planter.
2. Place the cup or can in the hole so the top is at or near ground level.
3. Fill the cup or can 1/3 full with soapy water if you want to kill the insects and bring them back to observe. Otherwise, leave the cup empty. (Some insects may crawl out of an empty cup.)
4. Place the plywood or cardboard cover over the cup or can. The four nails should go into the ground to hold the cover in place. The distance between the cup or can and the cover should be about 1/2 inch (1 1/4 cm). Too large a gap will allow mice or shrews to fall into the pitfall trap, and too small a gap won't allow insects to crawl in.
5. Place more than one pitfall trap in each of several different habitats to get a representative sample of insects.
6. Visit the pitfall traps daily to collect the insects. Make sure to bring more soapy water to refill the trap. Pour off the water in the trap (you may want to use a strainer) and place the insects in a plastic bag or a jar. Close the bag or jar and label it with the collection date and location of your pitfall trap. (If you are not using soapy water, pour the insects out onto a piece of white paper to observe them.)
7. Spread the insects out on a white sheet of paper to observe them. You may want to use forceps or tweezers. How many different kinds of insects did you collect?



pitfall trap

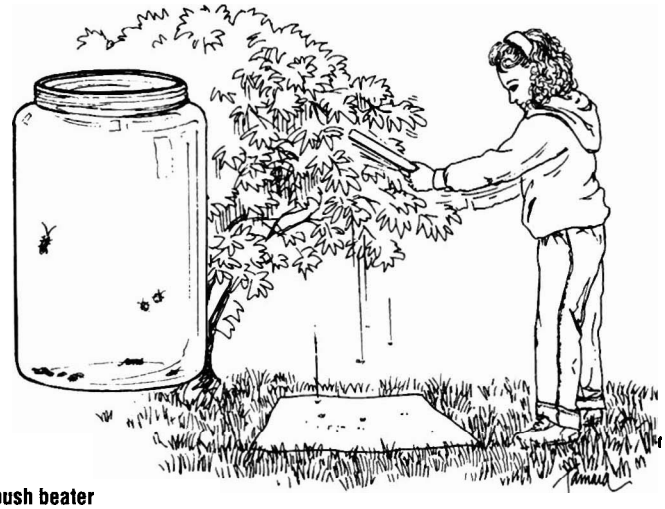
Bush Beater

What You Need

- a white bed sheet or a large piece of white plastic, about 1 square yard (1 meter by 1 meter)
- a plastic bag (e.g., a food storage bag)
- a bug box (available from a nature or biological supply company) or a clear jar with a lid

What to Do

1. Place the white sheet or the piece of white plastic under the bush.
2. Gently beat the bush with a stick and watch the insects fall onto the sheet or plastic.
3. You can observe the insects on the sheet or plastic. Or you can observe the insects in a bug box or a clear jar, following the instructions in step 4.



bush beater

4. Roll the sheet or piece of plastic into a funnel and pour the insects into the plastic bag. Transfer the insects to the bug box or clear jar by holding the plastic bag partly in the box or jar and turning it inside out. How many different kinds of insects did you collect?
5. Release the insects when you are finished looking at them.

Shake-it Box*

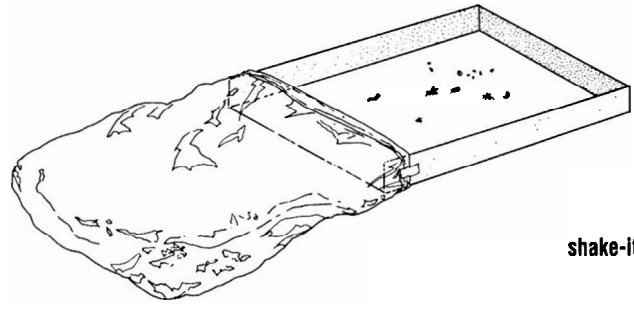
What You Need

- a shallow cardboard box, about 9 inches by 12 inches (about 23 cm by 31 cm)
- white paper to line the box if it is not already white
- tape
- a plastic bag to fit over the end of the box
- a bug box (available from a nature or biological supply company) or a clear jar with a lid

What to Do

To make the shake-it box

1. Cut off one edge of the box.
2. If the inside of the box is not white, line it with white paper, taping the paper in place.
3. Tape the plastic bag to the bottom and two sides of the box (see illustration).

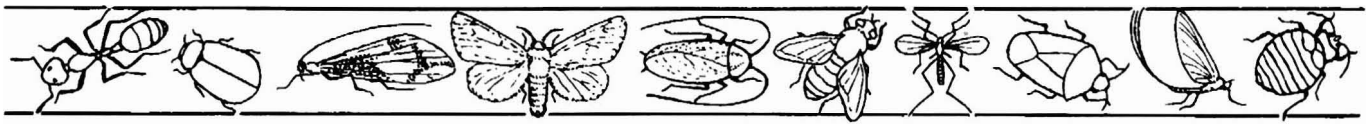


shake-it box

To use the shake-it box

1. Hold the box under a bush and shake the bush.
2. You can observe the insects in the box. Or you can observe the insects in a bug box or a clear jar, following the instructions below.
3. Tip the box so the insects slide into the plastic bag. Untape the bag from the box and close the bag so the insects don't get out.
4. Transfer the insects to the bug box or jar by holding the plastic bag partly in the box or jar and turning it inside out. How many different kinds of insects did you collect?
5. Release the insects when you are finished looking at them.
6. Retape the plastic bag to the box so you can use it again.

*Source: Cayuga Nature Center, *Curriculum Guide in Environmental Studies*



Sampling Net*

What You Need

- 4 feet (1.2 meters) of heavy, stiff wire, about 1/8 inch (0.3 cm) diameter

  a small wooden handle, about 1 yard (approximately 1 meter) long (A broom handle or a 3/4-inch dowel will work.)
- a drill with a bit the diameter of the wire
- a narrow wood chisel
- mosquito netting, 3 feet by 5 feet (about 1 meter by 1.5 meters)
- a needle, heavy thread, and sewing scissors
- cord, wire, or duct tape, about 5 feet (1.5 meters)
- a plastic bag (e.g., a food storage bag)
- a bug box (available from a nature or biological supply company) or a clear jar with a lid

What to Do

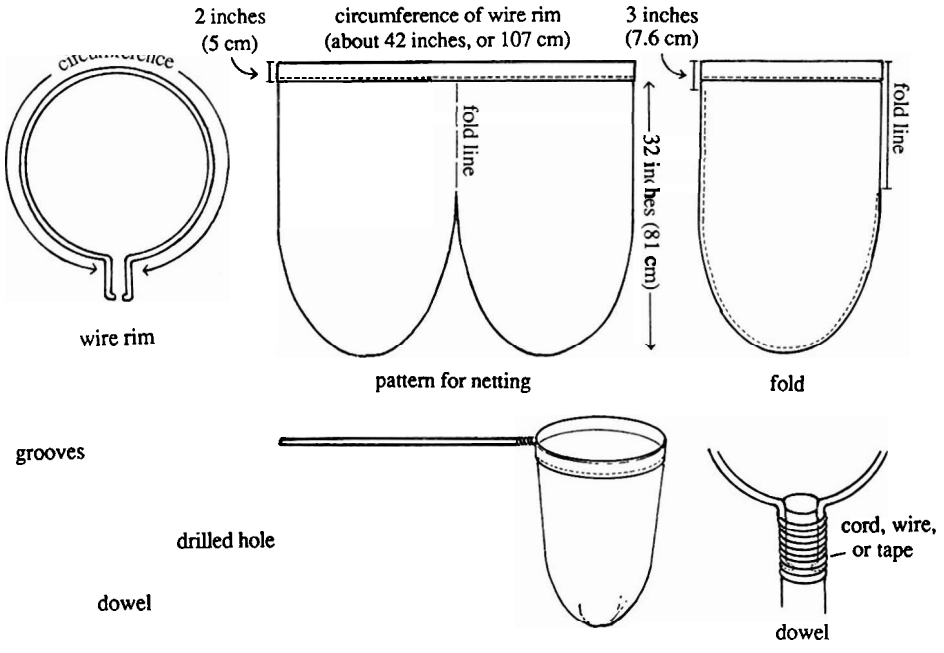
To make the sampling net

1. Bend the wire into the shape shown in the illustration.
2. Bore a hole and cut grooves in the broom handle or dowel as shown in the illustration.
3. Make the pattern for the netting as shown in the illustration.
4. Cut out the netting according to the pattern.
5. Fold over the long straight edge of the netting 1 1/2 to 2 inches (3.8 to 5 cm) and sew near the raw edge.
6. Fold the netting along the fold line, and beginning at the fold, sew the rounded edges together, leaving 3 inches (7.6 cm) unsewn.
7. Slip the bag on the wire and sew the rest of the seam by hand.
8. Attach the wire to the handle and wrap them with cord, wire, or tape.

To use the sampling net

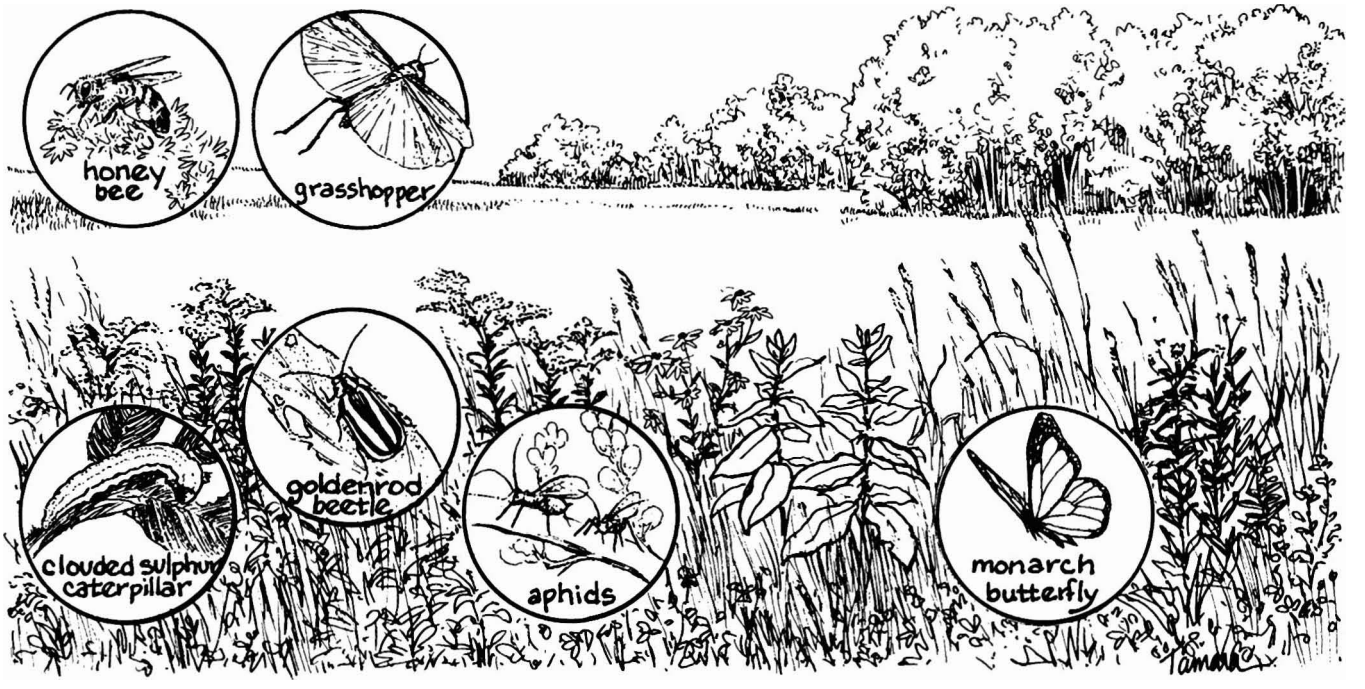
1. Swing the net through a field, lawn, or other area. Avoid thorny bushes.
2. Quickly turn the handle over so the net is folded over the ring. This prevents the insects from getting out.
3. Grasp the net in the middle, trapping the insects.
4. Place the insects in a plastic bag by holding the net in the bag and turning it inside out. Then transfer the insects to the bug box or jar by holding the plastic bag partly in the box or jar and turning it inside out. How many different kinds of insects did you collect?
5. Release the insects when you are finished looking at them.

*Source: Klass, *Know Your Insects*



sampling net

Activity 3: Insect Diversity



A diverse habitat with insects

How many different kinds of insects can your group find? Does the number of different kinds of insects depend on the habitat in which the sampling takes place?

In general, a habitat with a greater variety of plants will have a greater variety of insects. This is because specific insects feed or live on specific plants.

It is important to distinguish between the total number of insects and the number of different kinds of insects you find. For example, some houses may have many house flies, but few other kinds of insects. Outside in the garden, there may be a variety of insects including bees, butterflies, and beetles, but not many of any one kind.

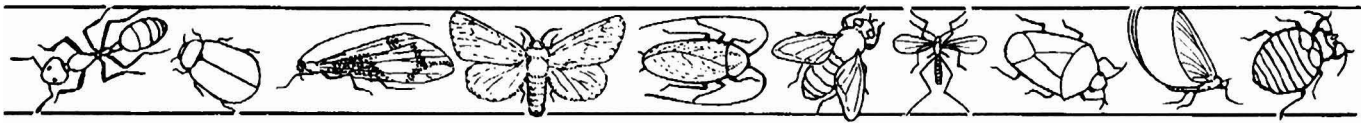
Your group can compare the numbers of different kinds of insects in different habitats using pitfall traps or a sampling net. With a bush beater or shake-it box, which collects samples from only one plant at a time, the youths can compare the numbers of different insects on different kinds of bushes. Or they can sample all the bushes in several different areas and see if the number of different kinds of plants is related to the number of different kinds of insects.

Identifying insects can be very challenging, even for trained entomologists. The youths may want to place insects into groups based on their physical characteristics and make up names for the groups. Alternatively, they may want to learn the commonly accepted names of the insects they collect. Field guides to insects are available at bookstores and libraries.

There are twenty-three major groups, or *orders,* of insects. More than three-fourths of all insects, however, belong to four main groups: the beetles; the butterflies and moths; the ants, bees, and wasps; and the flies. Within any one of these groups are many different species.

Scientists often use Latin names for insects. That allows scientists from different countries to communicate with each other. It also avoids confusion when one insect has several common names. Exploring the origin of Latin names for insect orders can be fun and helpful in remembering the name.

The captions of the illustrations beginning on page 15 give the common and Latin names of thirteen important orders of insects and the origins of the Latin names. A poster showing these orders of insects is included in the project folder



What Youth Discover

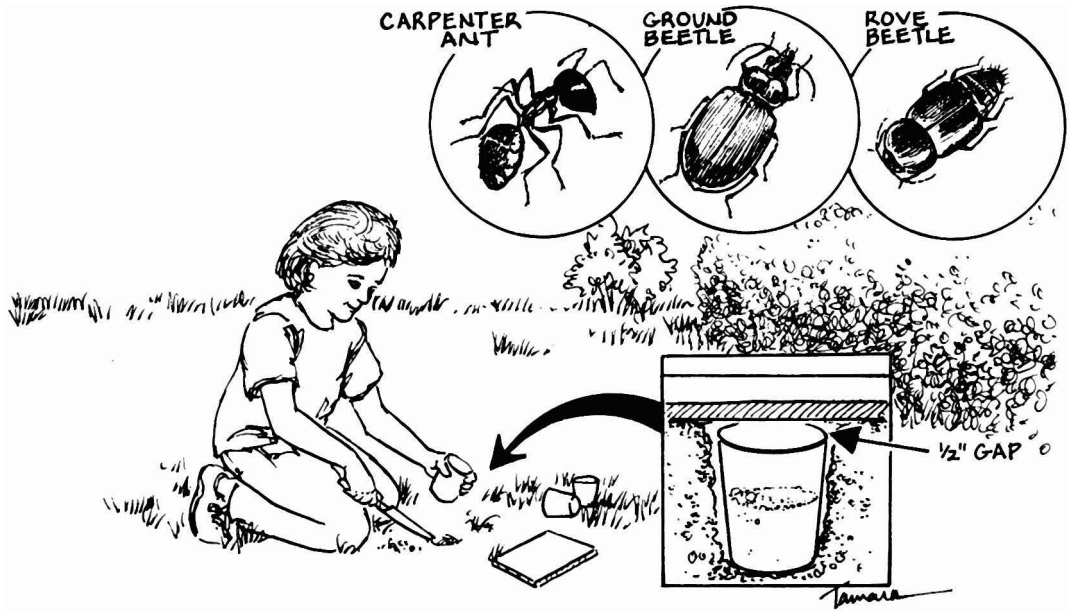
- The number of different kinds of insects varies, depending on the habitat.

What You Need

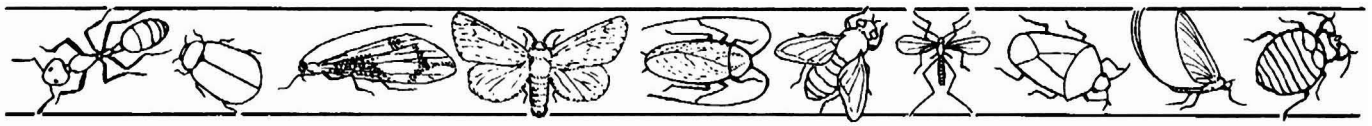
- one or more insect samplers for each youth or team of youths (Pitfall traps and sampling nets work best.)
- a bug box (available from a nature or biological supply company) or a clear jar with a lid
- copies of the Insect Diversity Activity Record for each group member

What to Do

1. Ask the youths to choose habitats in which they would like to collect insects. Possible habitats include a wooded area, a vacant lot, and a lawn.
2. Ask the youths to predict which habitats will have the highest numbers of different kinds of insects and which will have the lowest. Have them explain the reasons for their predictions.
3. Have the youths work individually or in teams. If using a sampling net, each youth or team should sample at least one habitat for 15 minutes, following the directions for using sampling equipment in Activity 2. If using pitfall traps, each youth or team should place five traps into each habitat and collect from the traps for several days.
4. Ask the youths to notice while they are sampling whether there are a lot of different kinds of plants, as in a forest or flower garden, or just a few, as in a lawn.
5. Have the youths bring their samples back to a central location and sort them into groups of the same kinds of insects or into groups of insects that look alike.
6. Discuss with the youths how many kinds of insects they found in the different habitats. Did the habitats with many different kinds of plants have many different kinds of insects?
7. Have the youths complete the Insect Diversity Activity Record.



Pitfall traps are used to collect insects crawling along the ground.



Insect Diversity Activity Record

Name: _____

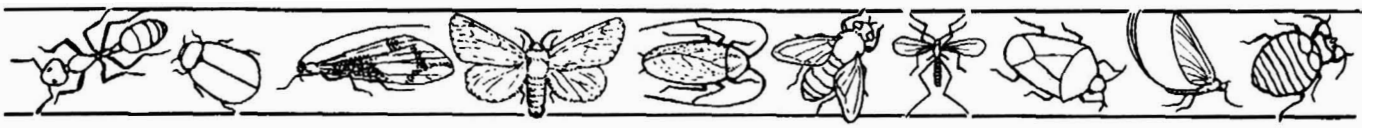
Date: _____

What kind of sampling equipment did you use?

How long did you sample? If you used pitfall traps, how many did you place in each area?

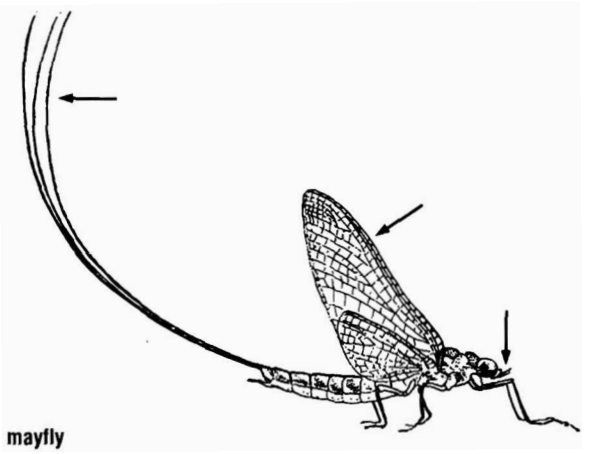
Describe the area(s) you sampled. How many different kinds of plants were in the area? Can you name or draw any of the plants?

How many different kinds of insects did you collect? Can you name or draw any of the insects?



Important Insect Orders

Mayflies (Ephemeroptera)

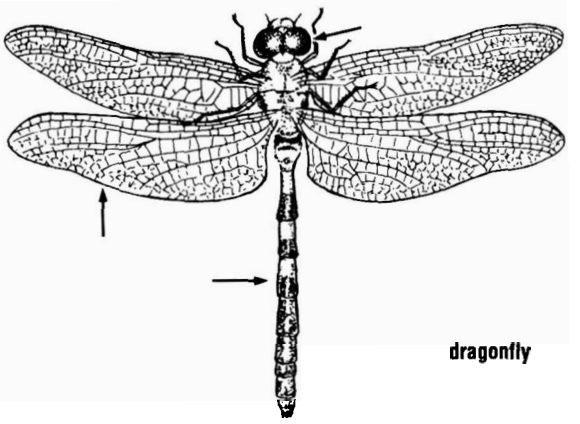


mayfly

The wings have many veins, which make a netlike pattern; the abdomen has three (sometimes two) long cerci, or "tails"; the antennae are short. Mayflies are commonly found in and around water.

The Latin name comes from the word *ephemeral*, meaning short-lived, and refers to the fact that the adults live only a day or two.

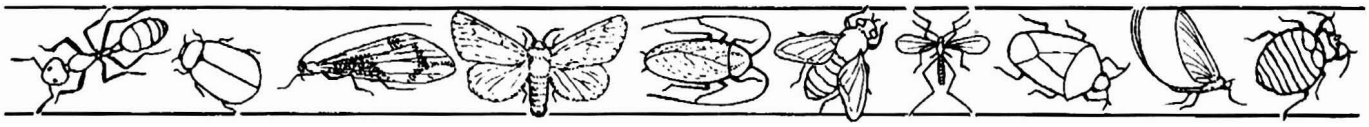
Dragonflies, damselflies (Odonata)



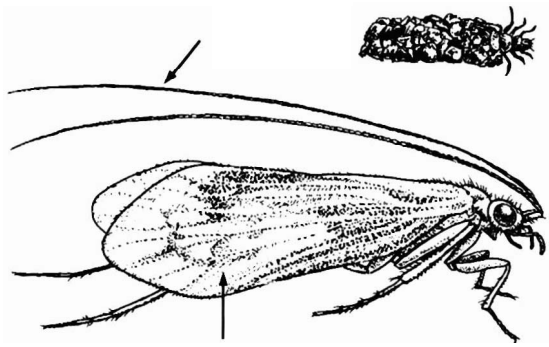
dragonfly

The wings and body are long and narrow; the eyes make up most of the head. Dragonflies and damselflies are voracious predators and are commonly found in and around water.

The Latin name comes from the Greek word for tooth (*odon*) and refers to the mouthparts.



Caddisflies (Trichoptera)

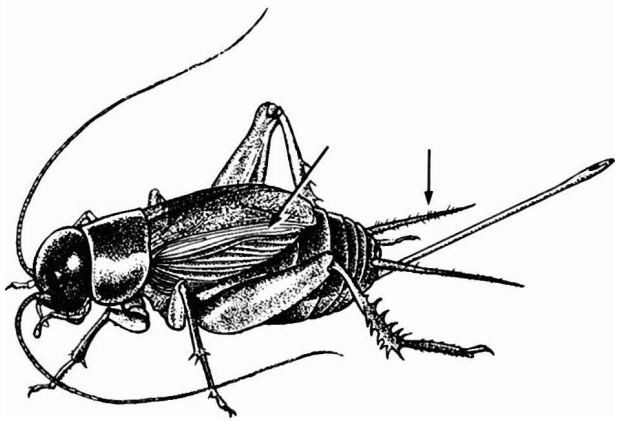


caddisfly

The wings are hairy; the antennae are long. The larvae often build protective cases to live in. Caddisflies are found in and around water.

The Latin name means hair (*tricho*) wings (*ptera*).

Grasshoppers, crickets, walking sticks, mantids, cockroaches, rock crawlers (Orthoptera)

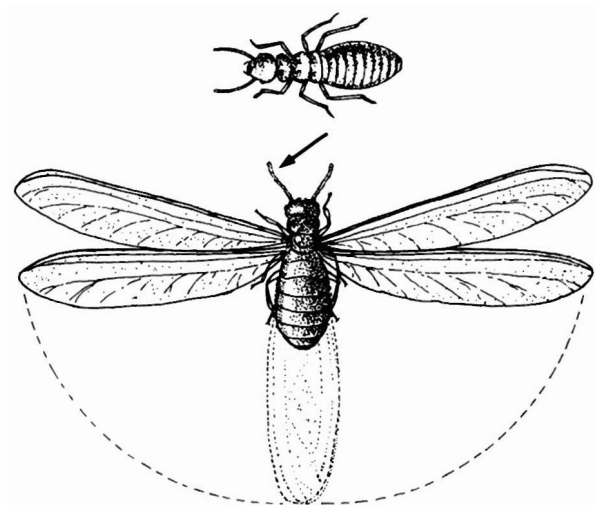


cricket

The wings may be well developed (grasshoppers, crickets), small, or absent (walking sticks); their cerci, or "tails," are usually well developed. Most are plant feeders.

The Latin name means straight (*ortho*) wings (*ptera*).

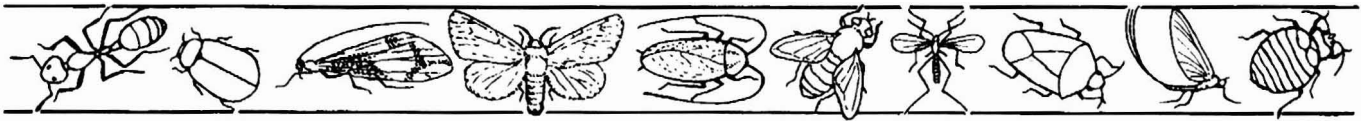
Termites (Isoptera)



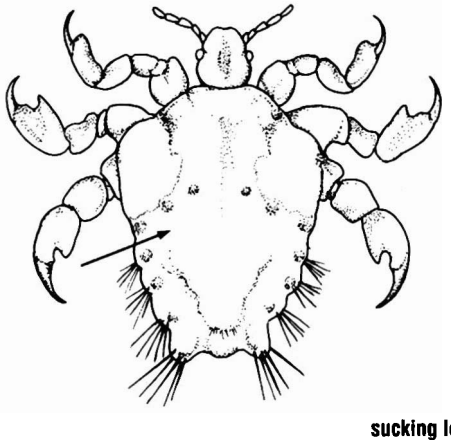
termite

The wings may be absent; their waists are broad; the bodies are soft and usually light colored; the antennae resemble strings of beads. Termites live in groups.

The Latin name means equal (*iso*) wings (*ptera*) and refers to the fact that the front and hind wings are the same size in many species.



Sucking lice (Anoplura)

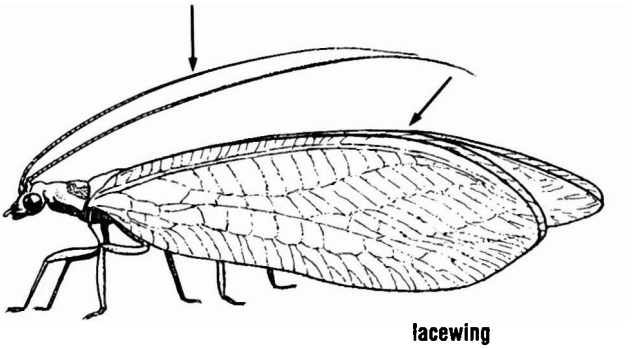


sucking louse

They have no wings; the body is flat. Sucking lice are parasites of mammals.

The Latin name means unarmed tail

Lacewings (Neuroptera)

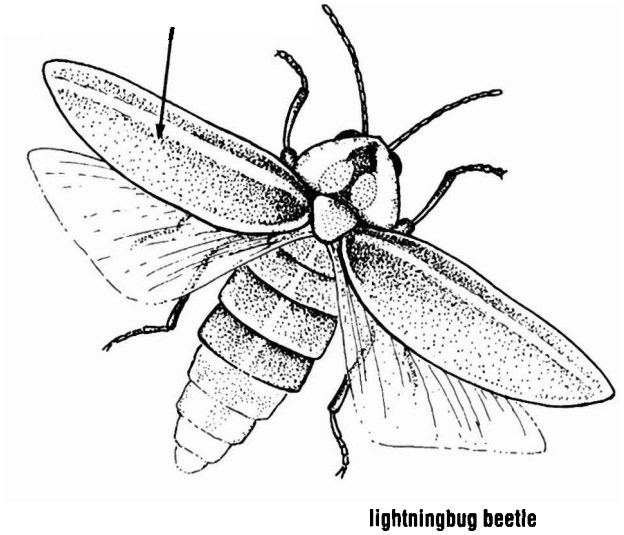


lacewing

The wings have many veins, which make them look like lace; the antennae are usually long; the bodies are soft. Most lacewings are predators.

The Latin name means nerve (*neuro*) wings (*ptera*) and refers to the many veins on the wings.

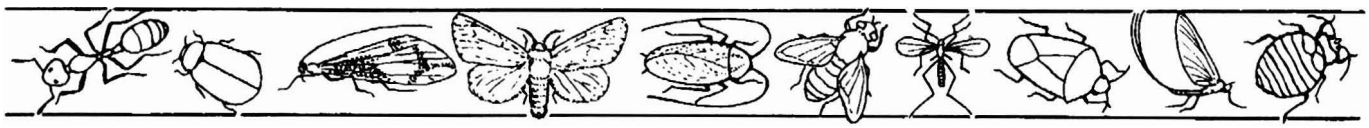
Beetles (Coleoptera)



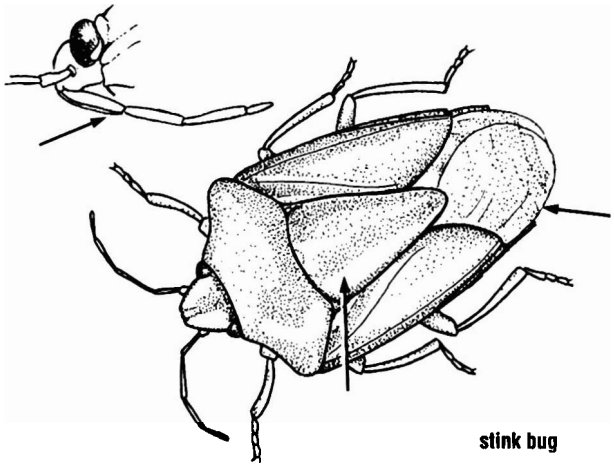
lightningbug beetle

The front wings are hard and form a protective sheath.

The Latin name means sheath (*coleo*) wings (*ptera*).



True bugs (Hemiptera)

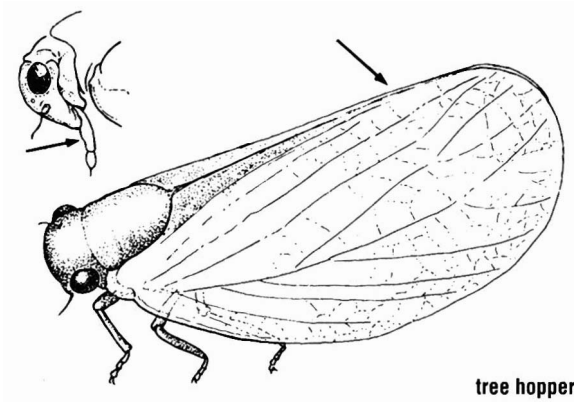


stink bug

The front wings are hard at the base, soft at the tips, and overlap to form triangles; the mouthparts form tubes for sucking.

The Latin name means half (*hemi*) wings (*ptera*) and refers to the fact that the bottom half of the front wing is hard and the top half is soft.

Cicadas, hoppers, aphids, scales (Homoptera)

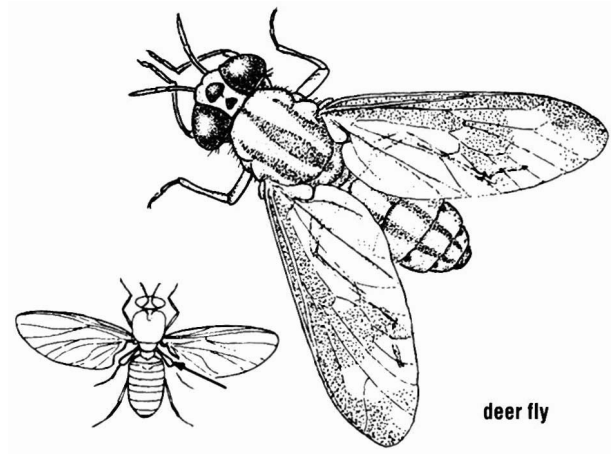


tree hopper

The mouthparts form tubes for sucking; the wings may be absent (scales and aphids) or folded like a roof over the body (cicadas and hoppers). These insects are plant feeders.

The Latin name means alike (*homo*) wings (*ptera*) and refers to the fact that the front wings have a uniform texture.

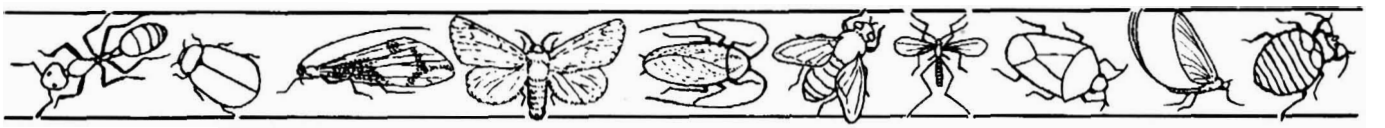
Flies (Diptera)



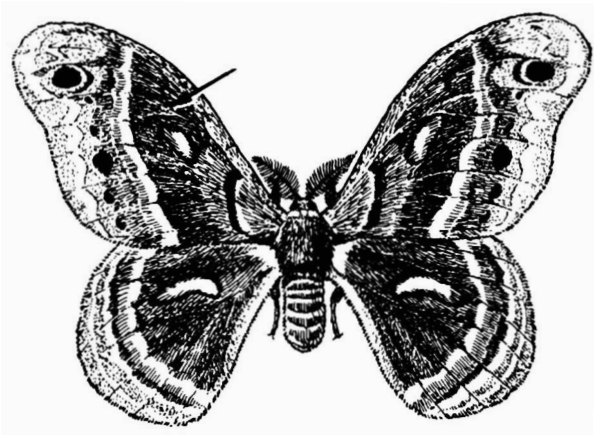
deer fly

Flies have one pair of front wings; there are small "knobs" in place of hind wings.

The Latin name means two (*di*) wings (*ptera*).



Butterflies, moths (Lepidoptera)

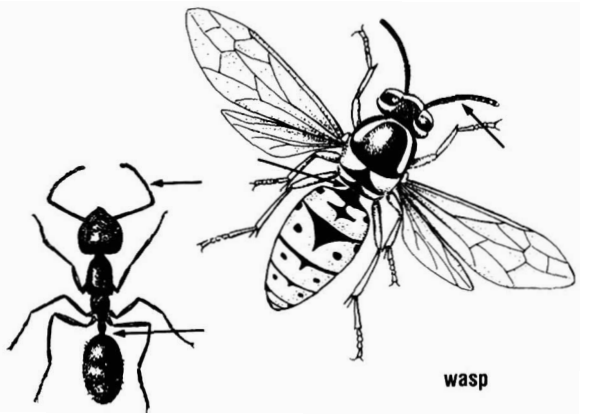


cecropia moth

The wings have scales that come off like dust on one's fingers when the insects are handled. (Note: It is best not to handle these insects.)

The Latin name means scale (*lepido*) wings (*ptera*).

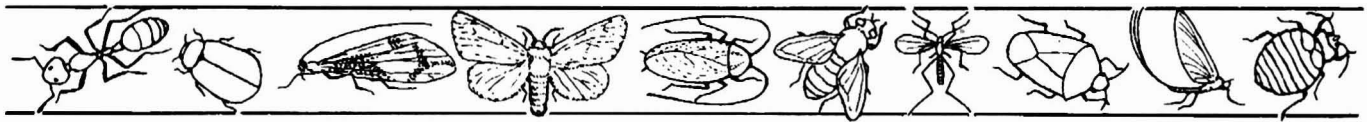
Bees, wasps, ants (Hymenoptera)



wasp

The waists of some are narrow; the antennae are long. Bees and wasps have wings. Ants have no wings.

The Latin name means god of marriage (*hymeno*) wings (*ptera*) and refers to the fact that the front and hind wings are joined by a row of tiny hooks.



Activity 4: Insect Observation

Like other animals, insects must eat—and avoid being eaten—to survive. Insects differ in their feeding habits. For example, many beetles eat leaves. Aphids suck the "juice" of plants. Dragonflies often eat other insects such as mosquitoes. Cockroaches and many flies are scavengers and eat dead organic material, including dead animals. Butterflies often drink nectar from flowers. Many flies, beetles, and bees consume pollen.

Ask your group to think of ways that insects avoid being eaten. Some insects move very quickly and suddenly, such as fast-flying dragonflies, quick-jumping grasshoppers, and fast-running cockroaches. Other insects sting or bite possible predators. You may have heard of stink bugs, which give off a foul-smelling odor when disturbed. Some insects scare off would-be predators with their startling colors. Others blend in with the colors of their surroundings, or are camouflaged. Still others build a shelter, such as by rolling up a leaf or weaving together many leaves, to avoid being seen.

In this activity, the youths in your group will get a chance to observe closely the eating and defensive behaviors of insects.

What Youth Discover

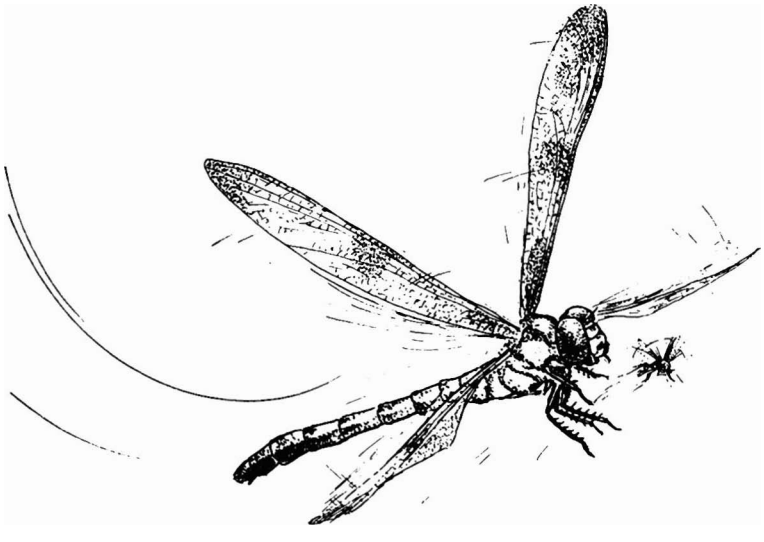
- Insects have a variety of eating and defensive behaviors.

What You Need

- a magnifying glass or hand lens for each youth (optional)
- copies of the Insect Observation Activity Record for each group member

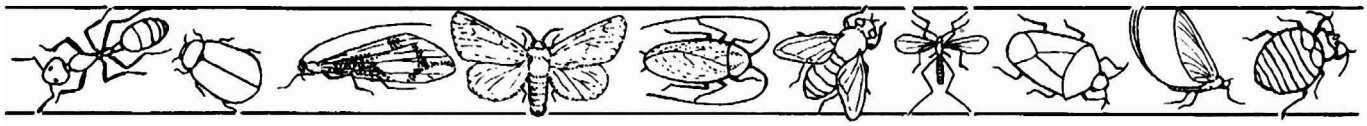
What to Do

1. Have the youths go outside (or, on a rainy day, into a building) and, alone or in pairs, find an insect to observe. They should spend at least 5 to 10 minutes observing a single insect. (Optional: a hand lens will help them observe the insect more closely.)



2. Move around among the youths, asking questions to help direct their observations. Ask the youths what the insect might eat. How does the insect obtain its food (for example, by chewing or sucking)? Does the insect demonstrate any behaviors that help it avoid being eaten? Suggest that the youths startle the insect by moving their hand nearby. Does the insect change its behavior? How?
3. Have the youths complete the Insect Observation Activity Record.

Tamara



Insect Observation Activity Record

Name: _____

Date: _____

Where did you observe the insect (for example, on grass in a field, on a bush in a woods, on dirt in a vacant lot)?

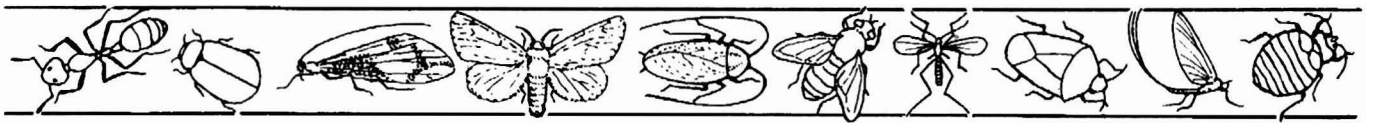
What kind of insect did you observe?

Use this space to draw a picture of the insect.

Was the insect eating? What do you think this insect eats?

Did the insect try to avoid being seen by you or another possible predator? If so, how?

How do you think this insect avoids being caught by a predator?



Activity 5: Insect Trivia

If the youths in your group have completed the activities described so far in this guide, they should know quite a bit about insects. They can learn even more by playing "Insect Trivia."

The project folder contains a packet of cards that are to be used to play the game. The packet includes three identical question cards, to be used by the leader and each team, and 45 different answer cards, each with a picture of an insect or insect relative on the front and correct answers to the questions on the back.

The first question asks whether or not the animal in the picture is an insect (1 point). The second question asks to what major group the animal belongs (2 points). The third question asks about the eating habits of the animal (3 points). The fourth question asks how the animal avoids possible predators (4 points). The fifth question asks how this animal might benefit or harm humans (5 points).

The youths may want to study the trivia cards before they play the game, because most of the information on the cards is not included elsewhere in this publication.

What Youth Discover

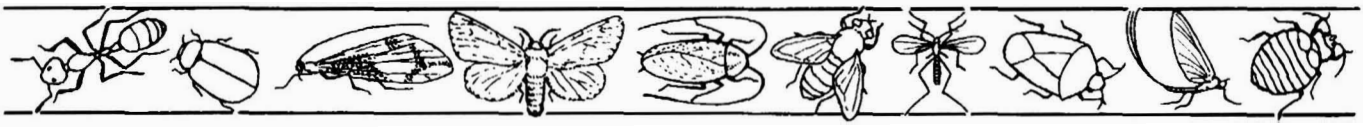
- Youth improve their knowledge of insect identification and behavior.
- Youth gain an understanding of how insects interact with humans.

What You Need

- Insect Trivia cards (in the project folder)
- a pencil and paper for keeping score

What to Do

1. Cut out the trivia cards.
2. Divide the youths into two teams. Give each team a question card.
3. Put the answer cards in a pile, with the pictures facing up.
4. The first team picks a card and, looking only at the front of the card, decides whether it wants to attempt to answer question 1, 2, 3, 4, or 5.
5. The first team hands the card to a member of the second team, who reads the appropriate question from the question card.
6. Members of the first team have 30 seconds to answer the question.
7. Teams continue to take turns, answering questions until all the cards are exhausted.
8. The adult leader judges whether the answer given to a particular question is close enough to the answer on the card to receive points.



Project Record

Name: _____

Date: _____

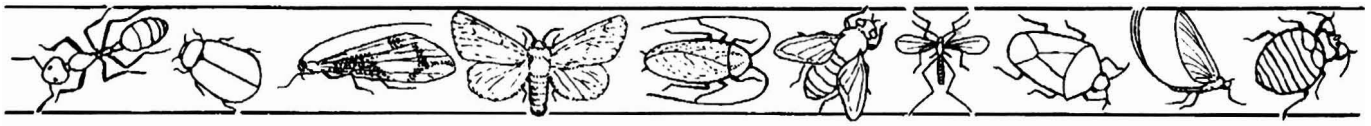
Can you name some of the important groups of insects?

List some of the things that insects eat.

List some of the ways that insects avoid or discourage predators.

List some of the ways that insects are important to humans.

List some of the ways that humans benefit and harm insects.



Glossary

abdomen: The hindmost of the three main body divisions of insects.

aquatic: Living in water

biological control: The use of natural enemies of insect pests, including other insects, microorganisms, or larger animals such as birds, to reduce harmful insect populations.

cephalothorax: In spiders, ticks, mites, scorpions, and crustaceans, the part of the body that consists of the head and thorax combined.

chemical control: The use of chemical insecticides to reduce harmful populations of insect pests.

compost: A rich soil-like material that is produced when organic materials such as garbage and weeds break down.

defensive behavior: Actions that protect oneself against predators.

dysentery: A disease of the digestive tract.

entomologist: A person who studies insects.

entomology: The study of insects.

gall: An abnormal growth on a plant, sometimes caused by an insect.

integrated pest management (IPM): The use of a variety of methods, including proper planting and cultivation practices and biological and chemical controls, to control pests.

larva (plural: larvae): An immature insect that looks completely different from the adult insect; for example, a caterpillar or a maggot.

maggot: A wormlike larva.

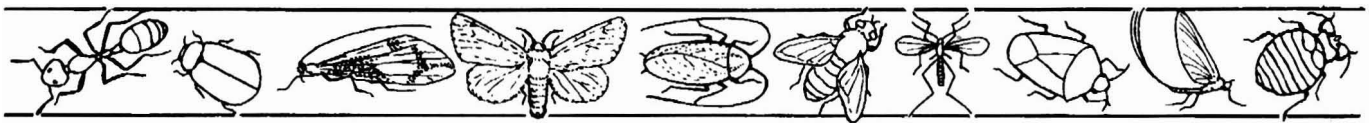
microorganisms: Tiny living things such as bacteria and viruses.

nymph: An immature insect that looks somewhat like the adult insect; for example, a dragonfly or mayfly nymph.

pollinate: To transfer pollen from male flower parts to female flower parts, thereby enabling a flower to form a seed or fruit.

predator: An animal that eats another animal.

thorax: The middle body segment of an insect, to which the legs and wings are attached.



For Further Information

Resources Used to Prepare This Publication

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Cayuga Nature Center. 1988. *Curriculum Guide in Environmental Studies, Grades Pre-K to 6.* Ithaca, N.Y.: Cayuga Nature Center, Inc.

Farb, Peter. 1962. *Life Nature Library. The Insects.* New York: Time Inc.

Klass, Carolyn. 1981. *Know Your Insects.* 4-H member's guide M-6-1. Ithaca, N.Y.: Cornell Cooperative Extension.

For More Youth Entomology Activities

The first two references include environmental education activities that focus on insects.

Cayuga Nature Center. 1988. *Curriculum Guide in Environmental Studies, Grades Pre-K to 6.* Ithaca, N.Y.: Cayuga Nature Center, Inc.

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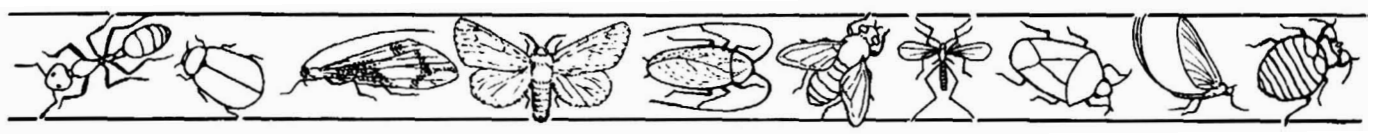
Field Guide

Borror, Donald J., and Richard E. White. 1970. *A Field Guide to the Insects of America North of Mexico.* Boston: Houghton Mifflin.



Activity 3: Insect Diversity

Insect Diversity Activity Record

Name: _____

Date: _____

What kind of sampling equipment did you use?

How long did you sample? If you used pitfall traps, how many did you place in each area?

Describe the area(s) you sampled? How many different kinds of plants were in the area? Can you name or draw any of the plants?

How many different kinds of insects did you collect? Can you name or draw any of the insects?

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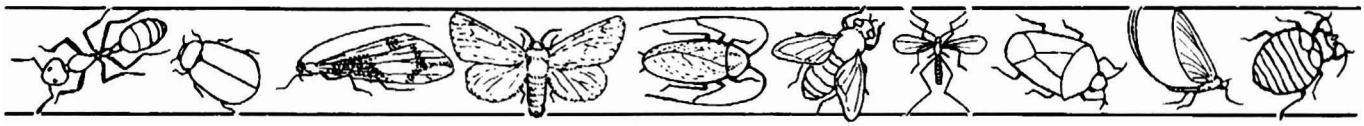

Activity 4: Insect Observation

Insect Observation Activity Record

Name: _____

Date: _____

Where did you observe the insect (for example, on grass in a field, on a bush in a woods, on dirt in a vacant lot)?

What kind of insect did you observe?

Use this space to draw a picture of the insect.

Was the insect eating? What do you think this insect eats?

Did the insect try to avoid being seen by you or another possible predator? If so, how?

How do you think this insect avoids being caught by a predator?

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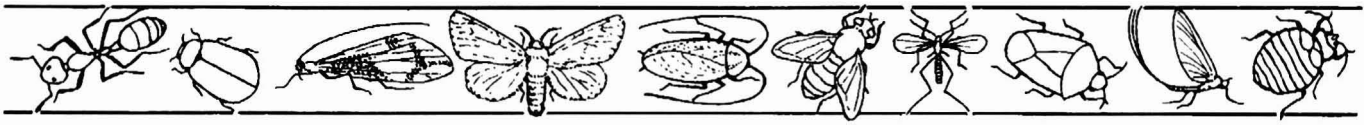

Insects All around Us

Project Record

Name: _____

Date: _____

Can you name some of the important groups of insects?

List some of the things that insects eat.

List some of the ways that insects avoid or discourage predators.

List some of the ways that insects are important to humans.

List some of the ways that humans benefit and harm insects.

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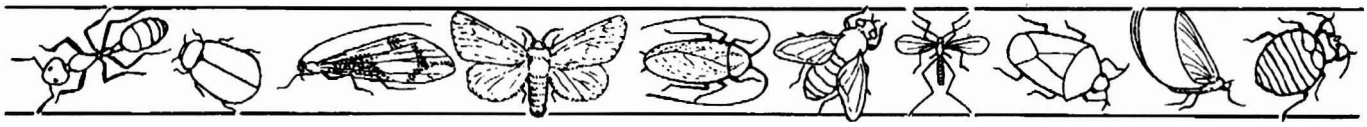

Insect Trivia

Instructions

1. Cut out the cards
2. Divide the youths into two teams. Give each team a question card
3. Put the answer cards in a pile, with the pictures facing up.
4. The first team picks a card and, looking only at the front of the card, decides to answer question 1 (1 point), 2 (2 points), 3 (3 points), 4 (4 points), or 5 (5 points).
5. The first team hands the card to a member of the second team, who reads the appropriate question from the question card.
6. Members of the first team have 30 seconds to answer the question.
7. Teams continue to take turns answering questions until all the cards are exhausted.
8. The adult leader judges whether the answer given to a particular question is close enough to the answer on the card to receive points.

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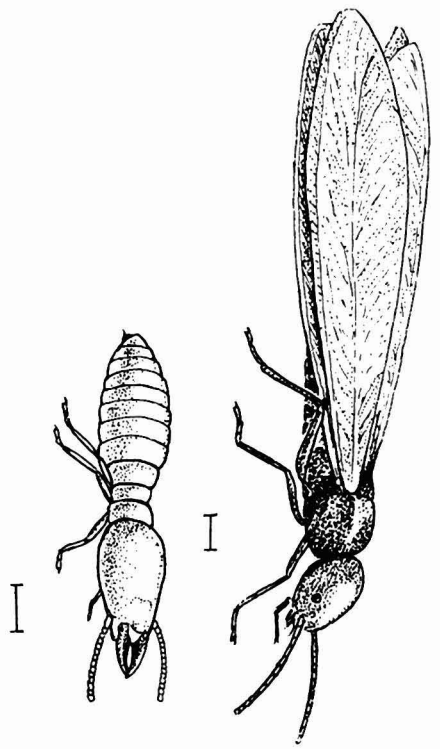

Questions

1. Is this an insect?
2. What is the name of this animal? To what major group of insects or insect relatives does it belong?
3. What does this animal eat?
4. How does this animal avoid or discourage predators?
5. How does this animal benefit people or cause harm?

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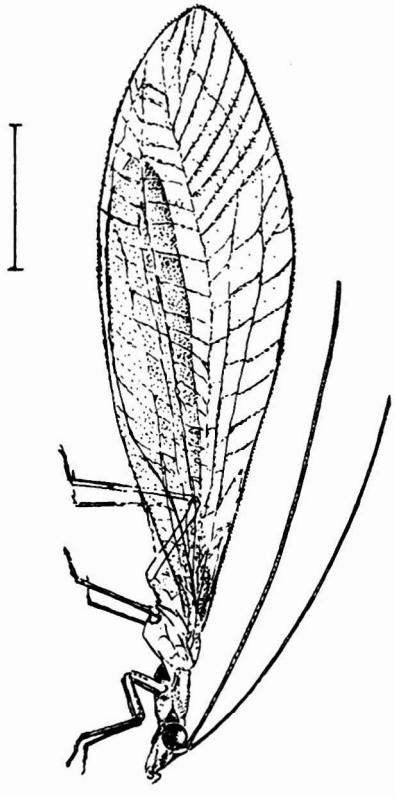
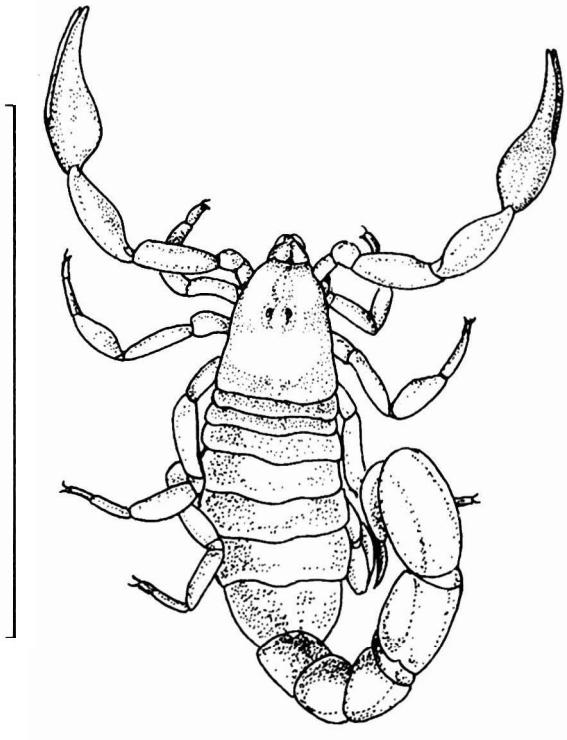
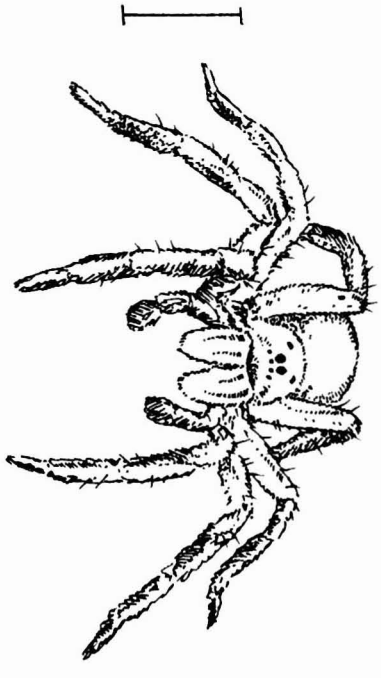
5. How does this animal benefit people or cause harm?

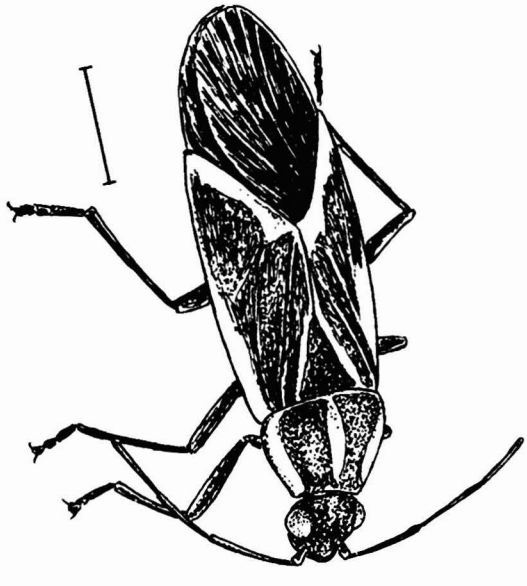
Termite

1. Yes.
2. Termite; termites (Isoptera)
3. Termites eat wood
4. Termites build nests, often underground or in wood, to protect themselves.
5. Termites break down dead trees and other organic materials in nature. They can cause major damage to wooden buildings, telephone poles, books, and fabric.









Boxelder Bug

1. Yes.
2. Boxelder bug; true bugs (Hemiptera)
3. Boxelder bugs feed on boxelders and sometimes other trees.
4. Boxelder bugs have an unpleasant taste. They are brightly colored (black with red markings) and thus easily recognizable. Predators recognize their bright coloring and remember their unpleasant taste.
5. The boxelder bug is a nuisance in the house, but it causes no real damage. It feeds on boxelder trees, but does little lasting harm.

Scorpion

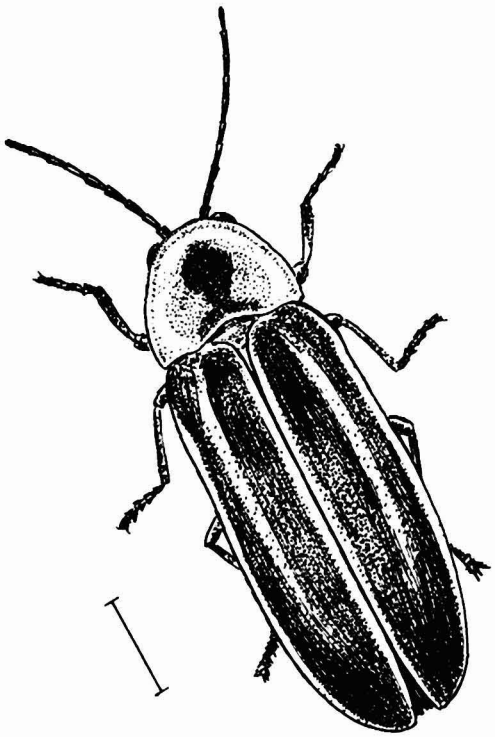
1. No.
2. Scorpion; spiders (Scorpionida, or more broadly, arachnids)
3. Scorpions feed on insects and spiders.
4. Scorpions are active at night and hide during the day. They sting potential predators.
5. Scorpions eat many kinds of harmful and beneficial insects. The sting of a scorpion is usually painful. Of the more than forty kinds of scorpions in the United States, only one has a sting that is poisonous and may kill humans.

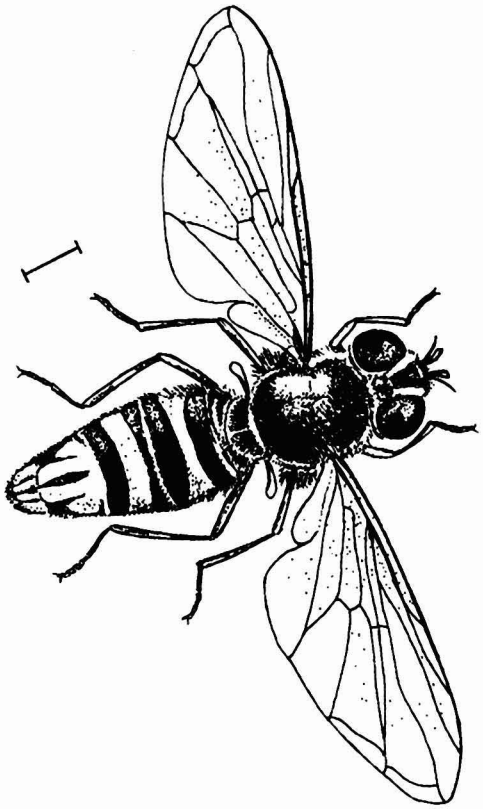
Wolf Spider

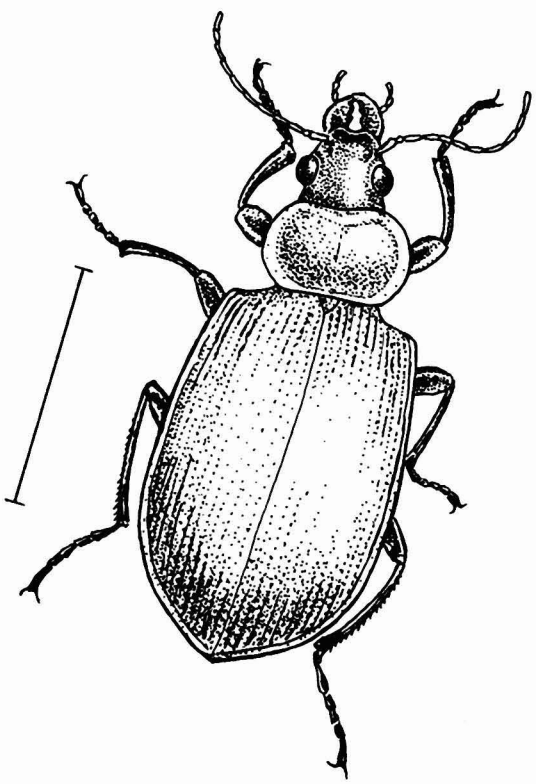
1. No.
2. Wolf spider; spiders (Araneida, or more broadly, arachnids)
3. Wolf spiders eat insects and sometimes small animals.
4. Many wolf spiders are active at night and hide during the day. They are large and run rapidly, frightening potential predators. Many live in burrows or under stones.
5. Wolf spiders eat many different kinds of harmful and beneficial insects.

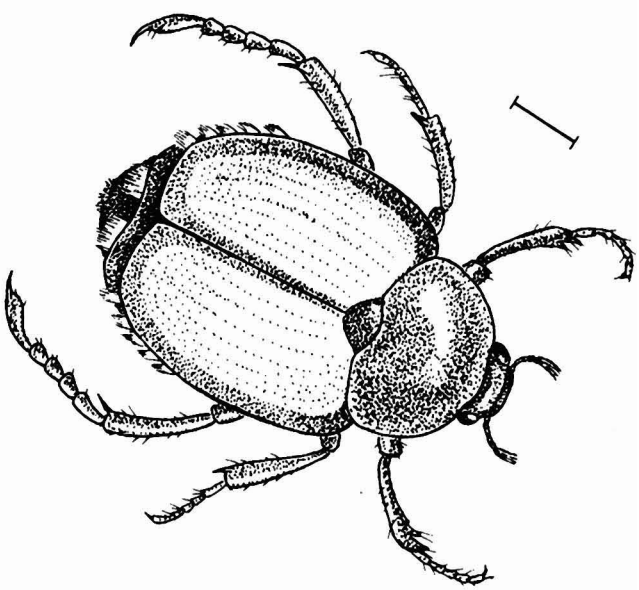
Lacewing

1. Yes.
2. Lacewing; lacewings (Neuroptera)
3. Lacewing larvae and adults feed on aphids and other insects. A single lacewing can eat more than 100 insects in a day.
4. Lacewings are usually dull colored and well camouflaged in their surroundings. Some lacewings give off a bad odor when disturbed.
5. Lacewings feed voraciously on aphids and other insect pests of plants.









Japanese Beetle

1. Yes.
2. Japanese beetle; beetles (Coleoptera)
3. Japanese beetle larvae feed on the roots of grasses. Adults feed on flowers, leaves, and fruits.
4. Japanese beetle larvae live in the soil, where predators have difficulty finding them. Adults drop off leaves to the ground when disturbed.
5. Japanese beetles feed on more than 275 different plants, often causing serious injury.

Flower or Hover Fly

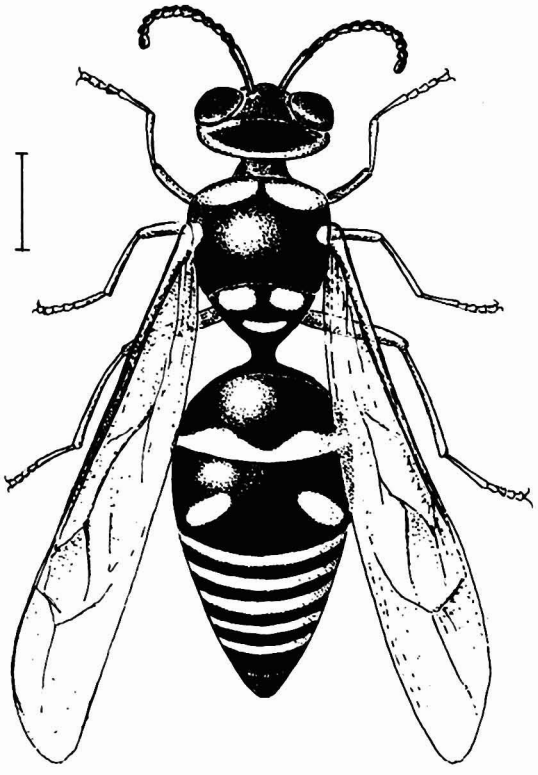
1. Yes.
2. Flower fly, hover fly, or syrphid fly; flies (Diptera)
3. Some flower fly larvae are predators and feed on aphids. The adults feed on pollen or nectar.
4. Flower flies move very quickly. They also imitate bees, and even though they don't sting, a potential predator may avoid a flower fly because it looks like a bee.
5. Some flower fly larvae eat aphids, and some adults are important pollinators.

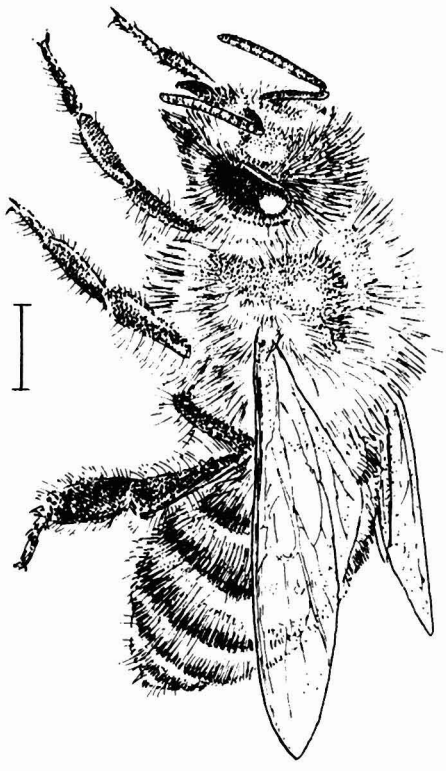
Ground Beetles

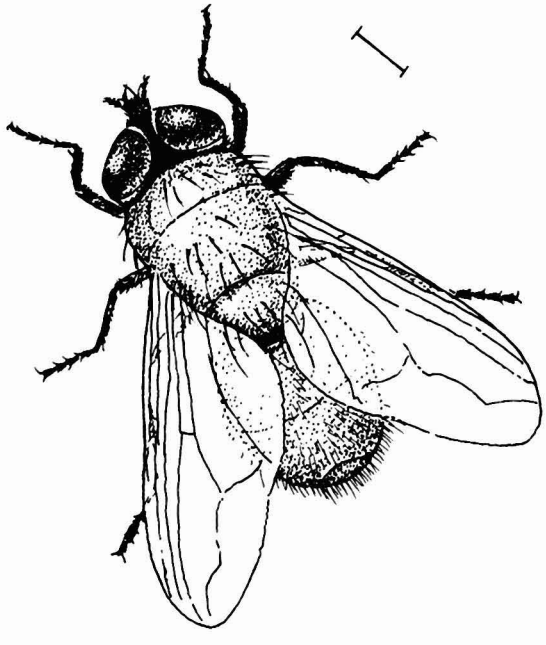
1. Yes.
2. Ground beetle; beetles (Coleoptera)
3. Nearly all ground beetle larvae and adults feed on other insects.
4. Ground beetles usually hide during the day and feed at night. Some ground beetles run quickly when disturbed. Some ground beetles (the bombardier beetles) give off a foul-smelling gas when disturbed. This gas can send ants into seizures and fend off toads.
5. Ground beetles eat snails, caterpillars, and other insects, many of which are pests of plants used by humans.

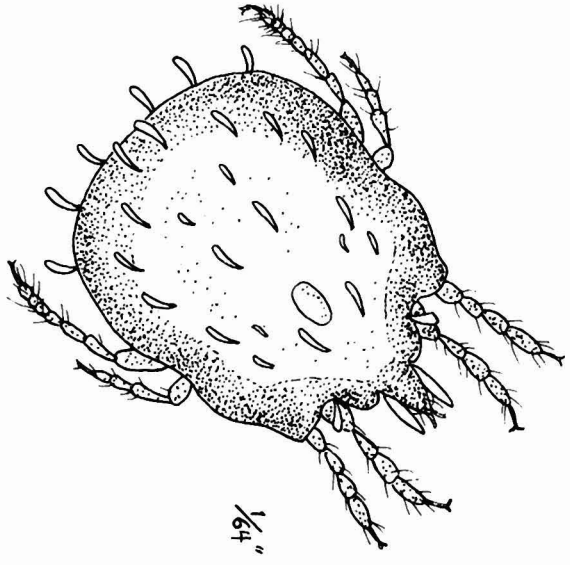
Lightningbug

1. Yes.
2. Lightningbug or firefly; beetles (Coleoptera)
3. Lightningbug larvae feed on snails and other insects. (The flash of the female attracts the males of other species, which the female lightningbug then eats.)
4. Lightningbugs avoid predators by flying at night.
5. The larvae feed on snails and other insects and are therefore an important part of the forest ecosystem.





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Mite

1. No.
2. Mite; mites and ticks (Acari, or more broadly, arachnids)
3. Mites eat a variety of things including blood, plants, insects, other mites, and decaying organic matter.
4. Mites are usually small and difficult to see.
5. There are many different kinds of mites. Some eat decaying organic matter, including garbage in compost piles. This helps recycle dead plants and animals into fertile soil. Some are important predators of harmful mites and insects. Others cause skin diseases in humans such as scabies (chiggers are a kind of mite). Certain mites cause diseases of chickens and other domestic animals. Others are serious pests of orchard trees, crops, and greenhouse plants.

Honey Bee

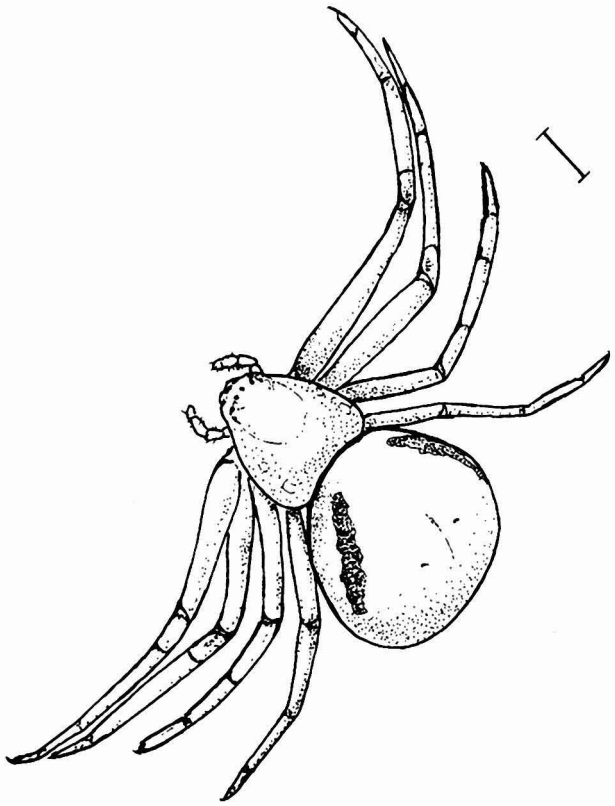
1. Yes.
2. Honey bee; bees, wasps, ants (Hymenoptera)
3. Honey bees eat pollen and nectar from flowers.
4. Honey bees move quickly, and they sting potential predators.
5. Each year honey bees produce millions of dollars worth of honey and beeswax. Their pollinating activities are essential to agriculture and are worth fifteen to twenty times the value of their honey and beeswax. Honey bees sting humans, sometimes causing an allergic reaction.

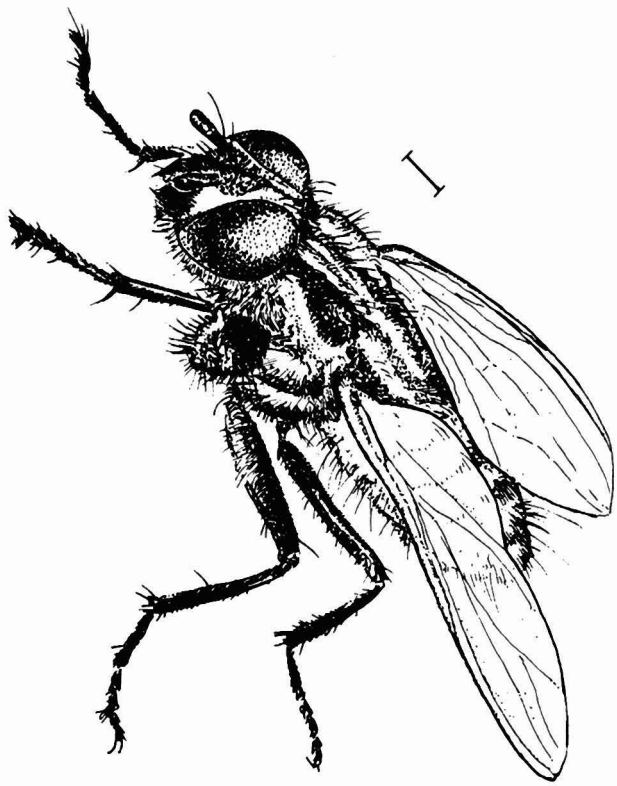
Blow Fly

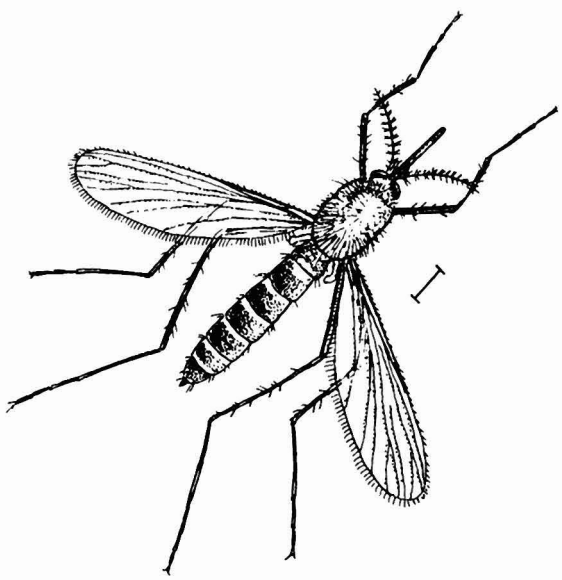
1. Yes.
2. Blow fly; flies (Diptera)
3. Blow fly larvae feed on living and dead flesh.
4. Blow flies move rapidly. Many scare away predators with their startling colors, such as metallic green or blue.
5. Blow flies help break down the flesh of dead animals. The larvae of some blow flies have been used to treat diseases. Blow flies carry organisms that cause human diseases such as dysentery. Some larvae live in the tissues of cows, bluebirds, and humans and cause disease.

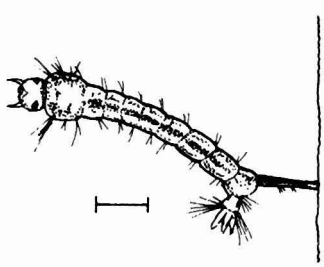
Wasp

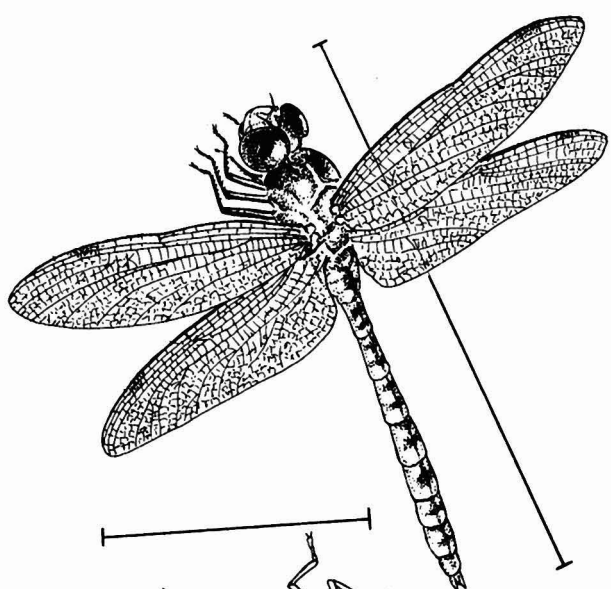
1. Yes.
2. **Was**p; bees, wasps, ants (Hymenoptera)
3. Wasp larvae eat other insects and spiders. The adults eat insects and nectar, sap, and other sweet foods, such as the fruit jam and barbecued chicken from your picnic.
4. Wasps often build protective nests, and they sting potential predators.
5. Some wasps are important pollinators of plants and predators of other insects. Certain wasps may sting people, sometimes causing a serious reaction.

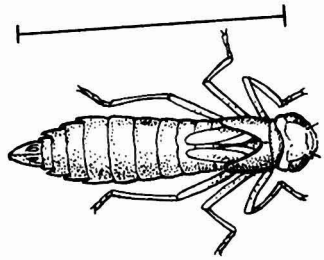












Dragonfly

1. Yes.
2. Dragonfly; dragonflies, damselflies (Odonata)
3. Dragonfly nymphs and adults eat many other insects, including mosquitoes.
4. Dragonfly nymphs can move very rapidly by taking water into their bodies and then expelling it. (This has been described as "jet propulsion.") Many dragonfly adults can fly very rapidly and turn suddenly.
5. Dragonflies eat many insects, including ones that are pests of humans, such as mosquitoes. Dragonfly nymphs are an important source of food for fish that people like to catch and eat.

House Fly

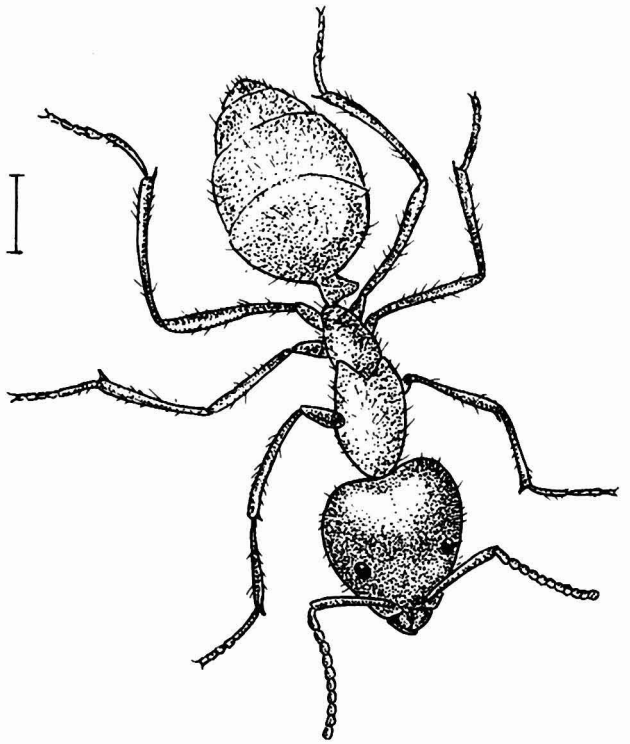
1. Yes.
2. House fly; flies (Diptera)
3. House fly larvae eat dead organic matter such as garbage Adults feed on almost anything.
4. House flies have large eyes that allow them to see predators. They can fly away quickly.
5. House flies help break down dead organic material including garbage and dead animals. They carry diseases such as typhoid fever and dysentery.

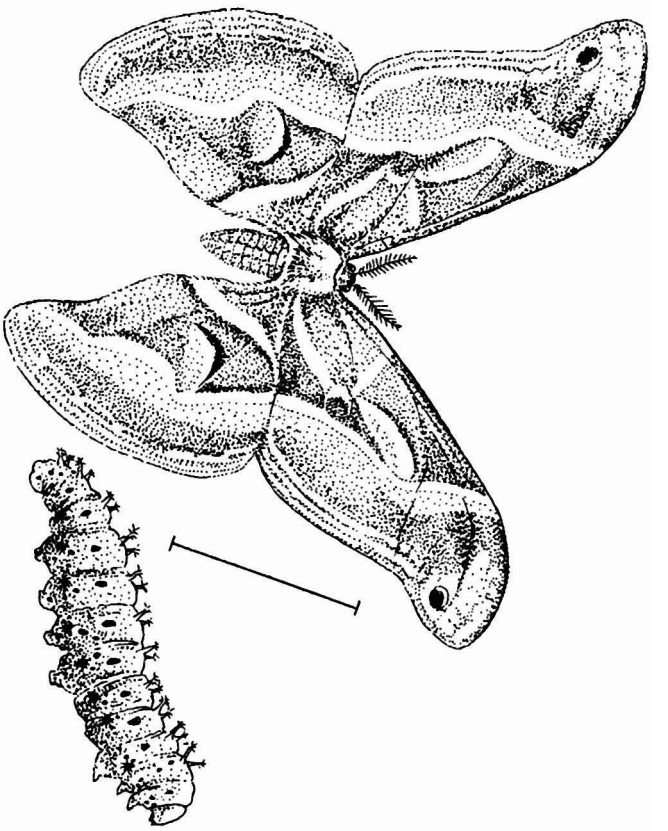
Mosquito

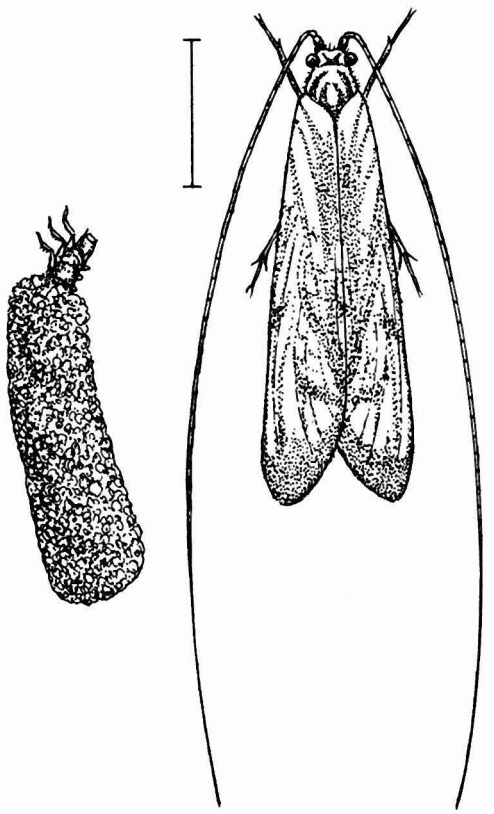
1. Yes.
2. Mosquito; flies (Diptera)
3. Female mosquitoes must have a meal of blood to reproduce. Males feed on nectar and other plant juices.
4. Mosquito larvae usually live on the surface of ponds and lakes but dive deeper into the water when startled.
5. Mosquitoes are an important source of food for fish that people like to catch and eat. Some mosquitoes carry microorganisms that cause malaria and yellow fever.

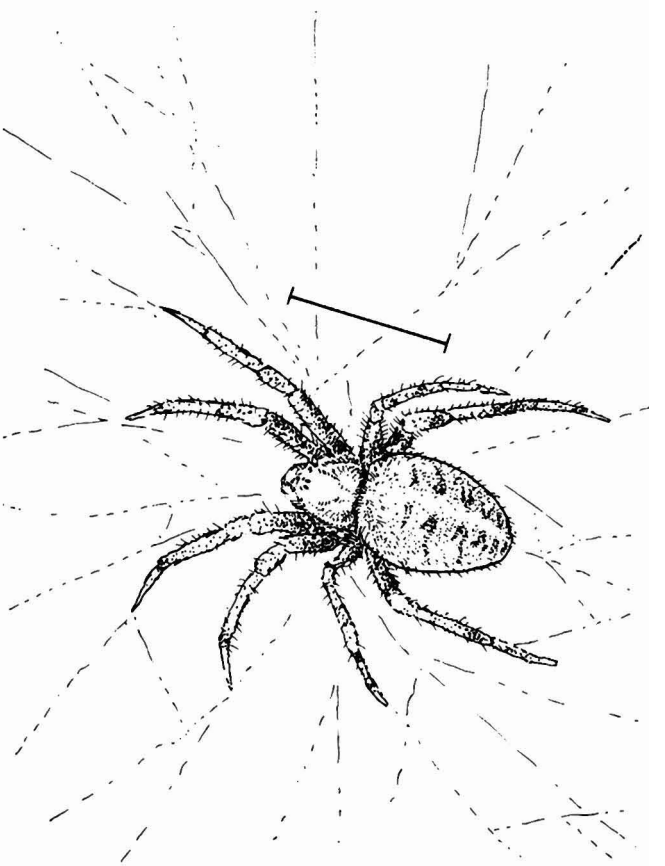
Flower Spider

1. No.
2. Flower spider, or crab spider; spiders (Araneida, or more broadly, arachnids)
3. Flower spiders live on flowers and eat insects that land on the flowers.
4. Flower spiders are usually similar in color to the flowers they live on, so they are camouflaged from their predators.
5. Flower spiders are colorful and interesting to watch. Although they kill insects that land on plants, including those that pollinate flowers, it is unlikely that they seriously reduce the number of pollinating insects.









Web Spider

1. No.
2. Spider; spiders (Araneida, or more broadly, arachnids)
3. Spiders eat insects.
4. Many spiders hide near their web.
5. Spiders eat many different insect pests. Spiders in the house may be annoying, but they do no damage. Only a few spiders are poisonous.

Cynthia Moth

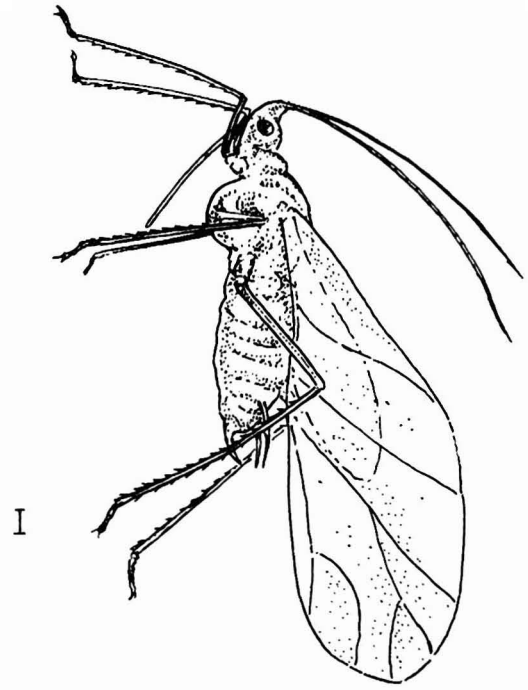
1. Yes
2. Cynthia moth; butterflies, moths (Lepidoptera)
3. Cynthia moth caterpillars eat the leaves of ailanthus trees. The adult moths do not eat.
4. Cynthia moths often live in city areas where there are few predators.
5. Cynthia moths, one of the few attractive moths that live in cities, provide enjoyment for city dwellers.

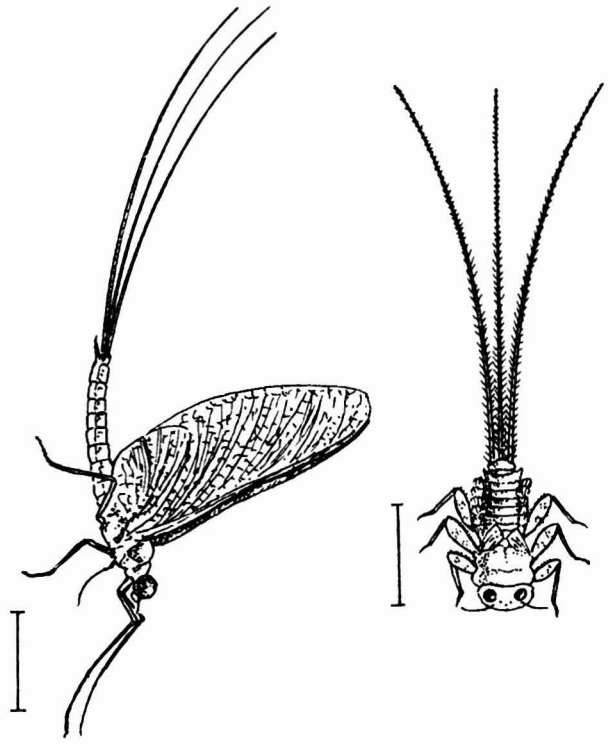
Caddisfly

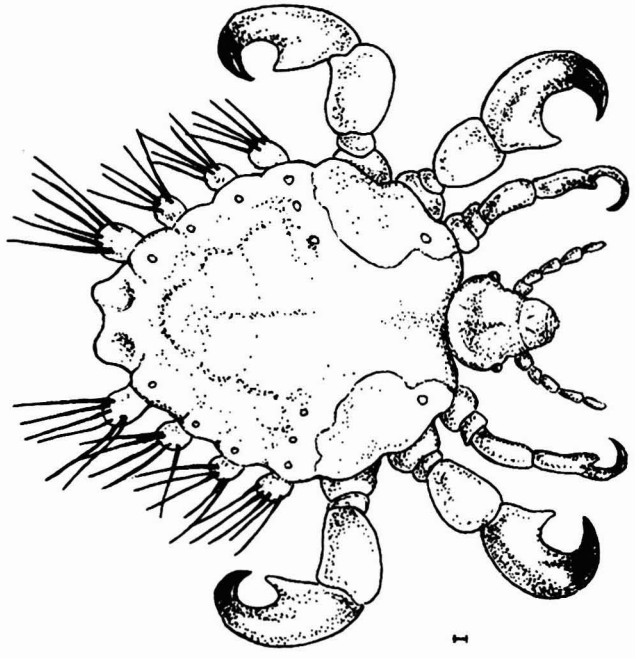
1. Yes.
2. Caddisfly; caddisflies (Trichoptera)
3. Caddisflies eat plants and other small animals.
4. Many caddisfly larvae live in protected cases built with bits of leaves, twigs, sand, or stone. Adults are generally dull colored and blend in with their surroundings.
5. Caddisflies are an important source of food for fish that humans like to catch and eat.

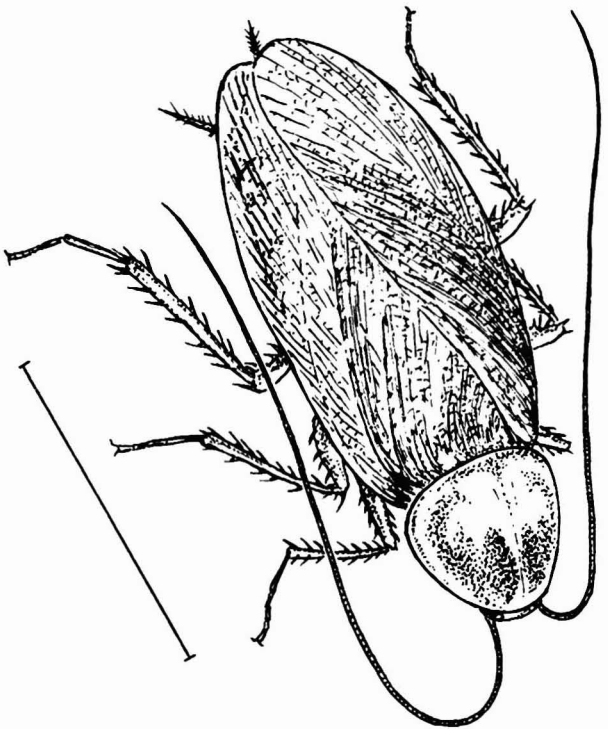
Ant

1. Yes.
2. Ant; bees, wasps, ants (Hymenoptera)
3. Ants eat many different things, including live and dead flesh, plants, sap, nectar, aphid honeydew, mushrooms, and human foods.
4. Ants can bite, sting, or give off a bad odor.
5. Ants are important predators of other harmful and beneficial insects. Some ants have a painful bite, and some protect aphids, which harm crops, by scaring away or attacking their predators.









Cockroach

1. Yes.
2. Cockroach; crickets, grasshoppers, walking sticks, mantids, cockroaches, rock crawlers (Orthoptera)
3. Cockroaches eat dead organic material and human food.
4. Cockroaches move quickly and hide in out-of-the-way places during the day.
5. Some cockroaches live in homes where they may contaminate food. (They do not, however, generally carry diseases.)

Mayfly

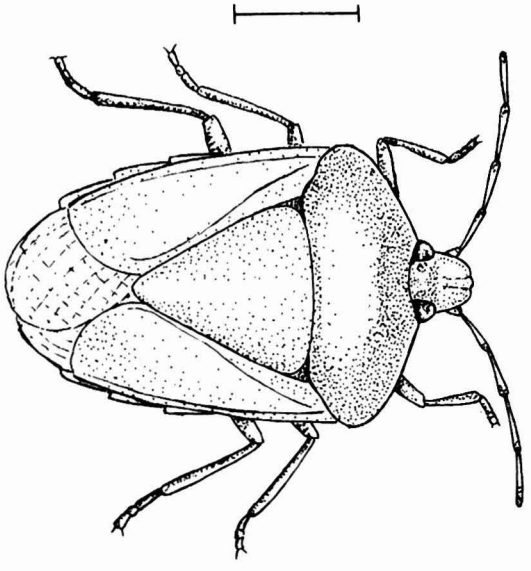
1. Yes.
2. Mayfly; mayflies (Ephemeroptera)
3. Mayfly nymphs feed on live or dead plant material. The adults live only a day or two and do not feed.
4. Adult mayflies are very numerous and live only a few days, thereby overwhelming their predators with too much food at one time. The nymphs are usually dull colored and may hide under rocks.
5. Mayflies are a source of food for fish that people like to catch and eat. Mayflies are used to indicate the health of a stream because they are usually found in clean water.

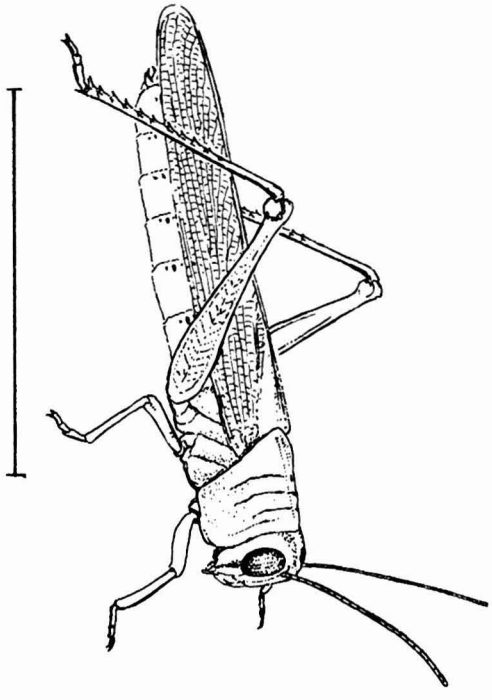
Sucking Louse

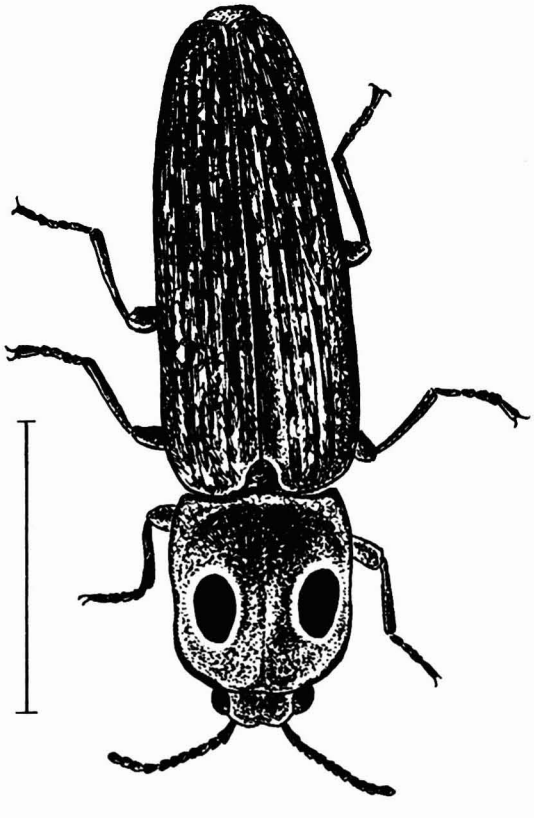
1. Yes.
2. Sucking louse; sucking lice (Anoplura)
3. Lice eat the blood of humans and other animals.
4. Lice are very tiny and live in hard-to-get-at places, such as hair and the seams of clothes.
5. The crab louse, head louse, and body louse attack humans and cause itching. The body louse can carry the organisms that cause typhus or black plague. Other lice attack domestic animals.

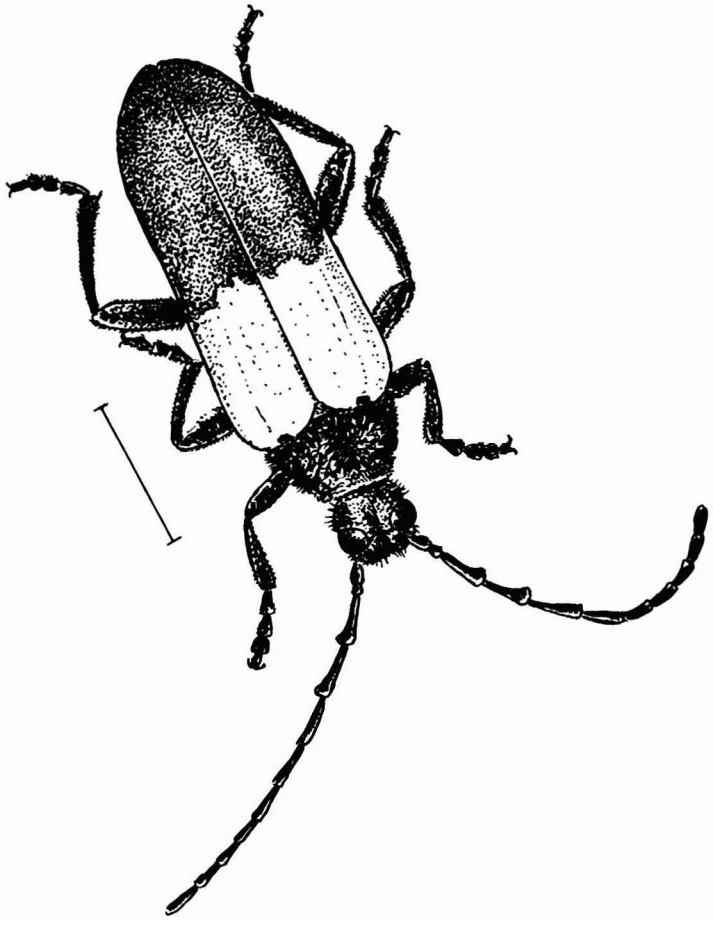
Aphid

1. Yes.
2. Aphid; cicadas, hoppers, aphids, scales (Homoptera)
3. Aphids feed on the sap of plant stems and leaves.
4. Aphids are difficult to find because they are small and dull colored and often live under leaves. Some aphids excrete a sweet honeydew, which attracts ants. The ants, in turn, protect the aphids by scaring away or attacking possible predators.
5. Many aphids are crop pests and may carry diseases into crops. Crops affected by aphids include apples, potatoes, peas, cabbage, and corn. Aphids also harm forest and ornamental trees, including pine, spruce, hickory, and sycamore. They produce a sticky substance called honeydew, which can drop onto cars and sidewalks.









Long-horned Beetle

1. Yes.
2. Long-horned beetle; beetles (Coleoptera)
3. Long-horned beetles eat wood.
4. Some long-horned beetles are brightly colored and scare away their predators. Others are dark colored and blend in with their surroundings. They hide from predators under bark during the day and are active at night.
5. Many adult long-horned beetles pollinate plants. They also break down dead wood in the forest. The larvae bore into the wood of shade, forest, and fruit trees and freshly cut logs, causing considerable damage.

Grasshopper

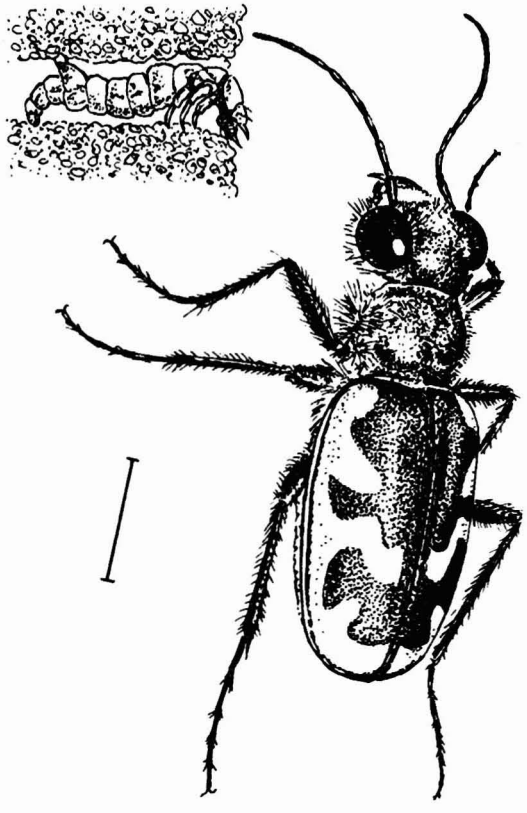
1. Yes.
2. Grasshopper; grasshopper, cricket, walking stick, cockroach, rock crawler (Orthoptera)
3. Grasshoppers eat many kinds of plants, including important crops.
4. Grasshoppers jump away quickly from predators.
5. Grasshoppers feed on many important crops.

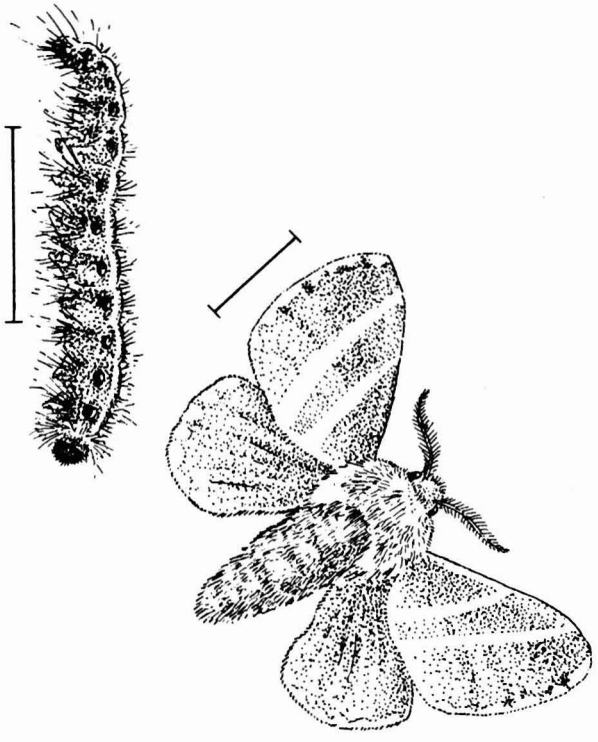
Click Beetle

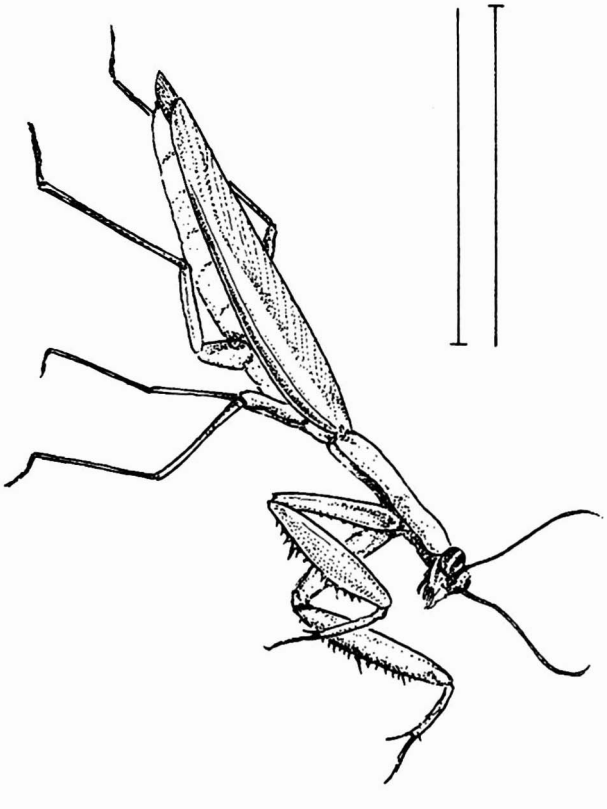
1. Yes.
2. Click beetle; beetles (Coleoptera)
3. Click beetle larvae eat the roots and seeds of important crops and sometimes other insects.
4. Click beetles are able to jerk their bodies suddenly, spinning end over end in the air, while making a clicking sound. The sudden motion startles potential predators. The larvae live in soil and other protected places, such as under the bark of dead trees.
5. Some click beetle larvae eat harmful insects. The larvae of many click beetles feed on newly planted seeds and the roots of beans, cotton, potatoes, corn, and cereals.

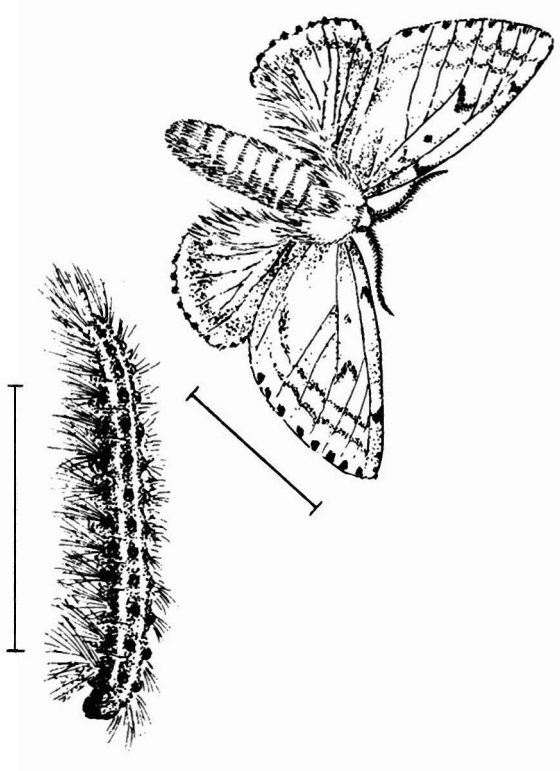
Stink Bug

1. Yes.
2. Stink bug; true bugs (Hemiptera)
3. Stink bugs eat plants or other insects.
4. Stink bugs have an unpleasant odor and taste. Most are brightly colored; thus they are easily recognized by predators who remember their bad odor and taste.
5. Stink bugs are pests of cabbages and other plants.









Gypsy Moth

1. Yes.
2. Gypsy moth; butterflies, moths (Lepidoptera)
3. Gypsy moth larvae eat the leaves of deciduous trees, especially oaks. They eat conifer needles only when starving.
4. Larvae feed at night and hide during the day. They are generally dull colored and blend in with their surroundings. They are also hairy and therefore distasteful to birds.
5. Gypsy moths cause extensive damage to forest and ornamental trees, occasionally killing them.

Eastern Tent Caterpillar

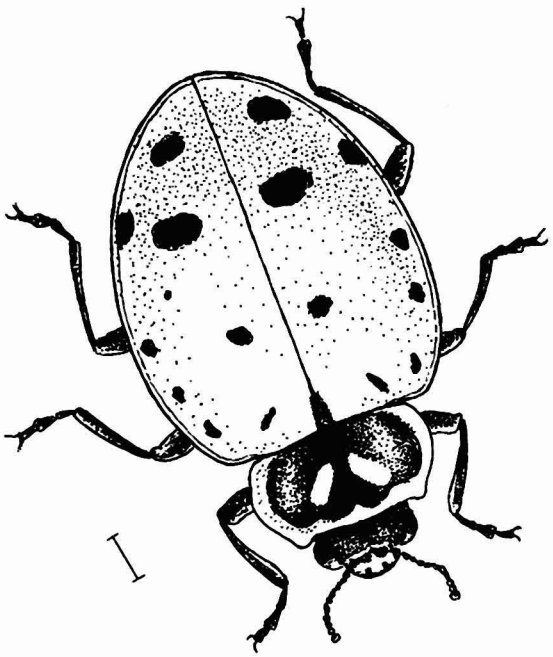
1. Yes.
2. Eastern tent caterpillar; butterflies, moths (Lepidoptera)
3. Eastern tent caterpillars eat the leaves of many trees.
4 Eastern tent caterpillars build tents that protect them from some predators.
5. Eastern tent caterpillars often weaken orchard and ornamental trees by eating their leaves. They build unsightly tents in ornamental trees.

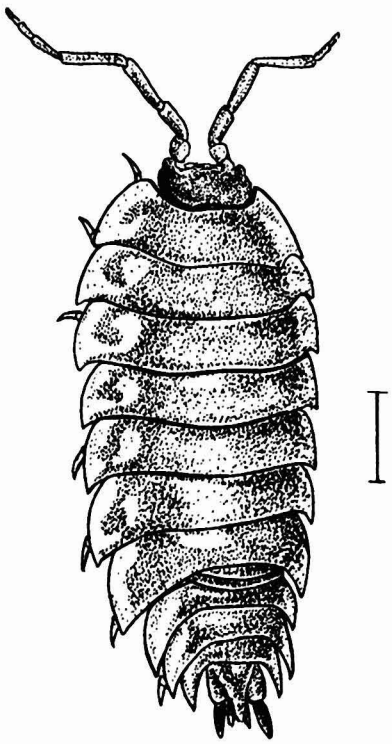
Praying Mantis

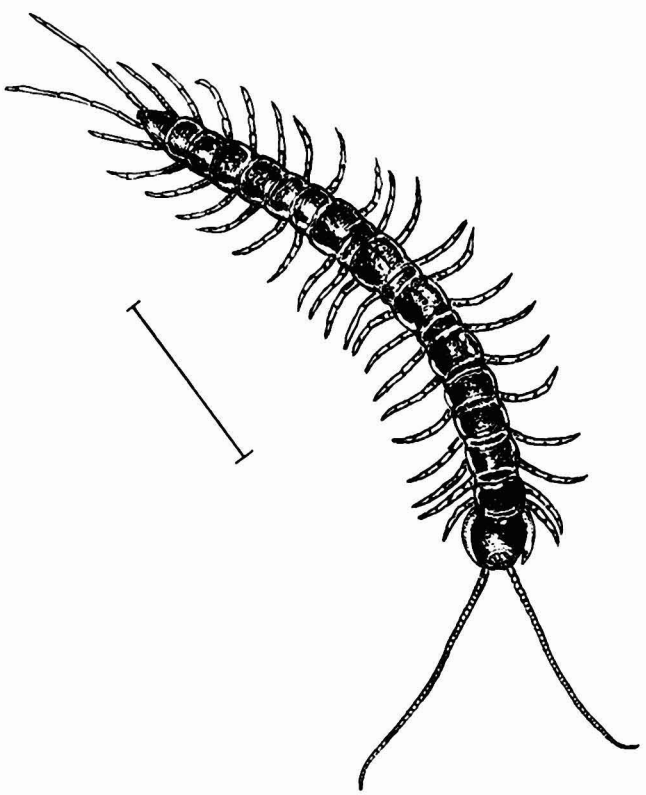
1. Yes.
2. Praying mantis; crickets, grasshoppers, walking sticks, mantids, cockroaches, rock crawlers (Orthoptera)
3. Praying mantises eat many insects.
4. Praying mantises are brown or green and blend in with their surroundings.
5. Praying mantises eat insect pests, particularly those living in meadows and pastures.

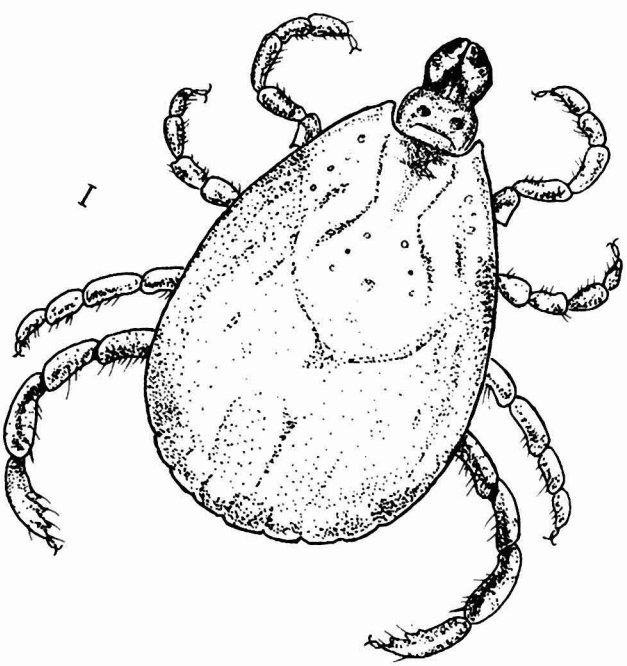
Tiger Beetle

1. Yes.
2 Tiger beetle; beetles (Coleoptera)
3. Tiger beetles eat many small insects.
4. Tiger beetles take flight almost instantly, sometimes after running a short ways, and land some distance away facing their pursuer. They are shiny and brightly colored. Sometimes they bite. The larvae live in burrows in the ground and anchor themselves with a spine so they can't be pulled out.
5. Tiger beetles feed on a variety of small harmful and beneficial insects. They are beautiful to observe.









Tick

1. No.
2. Tick; ticks and mites (Acari, or more broadly, arachnids)
3. Female ticks feed on blood.
4. Ticks are small and flat and therefore not easily seen. They hide in the fur of their host animals.
5. Ticks carry microorganisms that are responsible for giving people and animals Lyme disease, Rocky Mountain spotted fever, and tick paralysis.

Sowbug

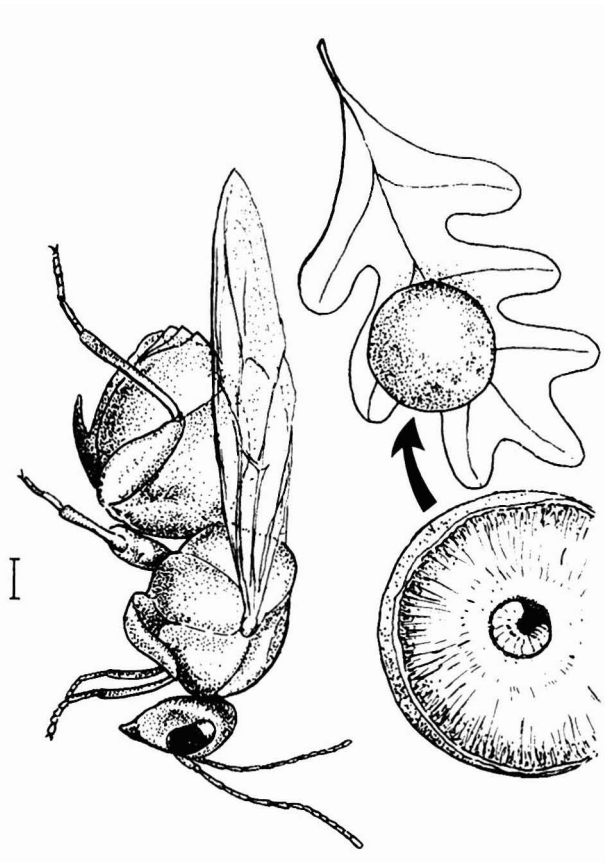
1. No.
2. Sowbug or pillbug; (Isopoda, or more broadly, crustaceans)
3. Sowbugs eat plants and dead organic material.
4. Sowbugs are dull colored and not easily seen. They live under stones, boards, or bark. Some sowbugs roll up in a ball if disturbed, thus making themselves hard to eat.
5. Some sowbugs eat dead organic matter, including garbage in compost piles. This helps recycle dead plants and animals into fertile soil. Other sowbugs are pests of crops.

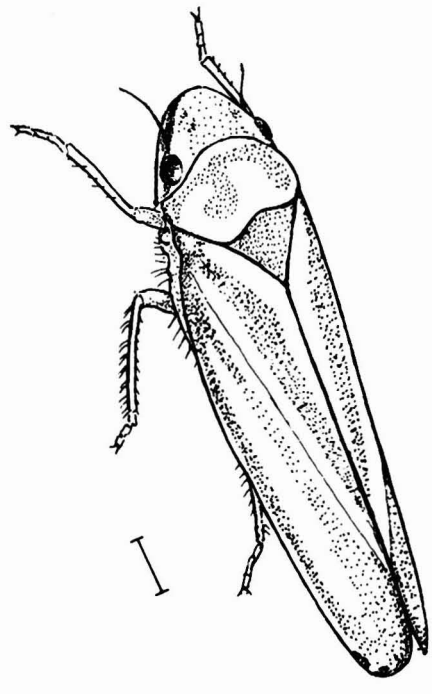
Centipede

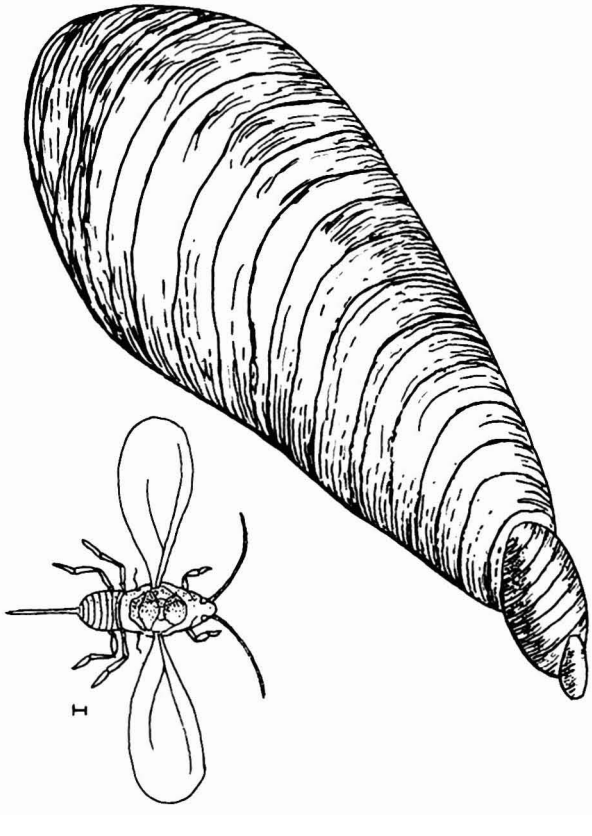
1. No.
2. Centipede; centipedes (Chilopoda)
3. Centipedes eat insects, spiders, and other small animals.
4. Centipedes live in protected places, such as in the soil, under bark, or in rotten logs. They are able to run quickly.
5. Some centipedes eat dead organic matter; this helps recycle dead plants and animals into fertile soil. Large centipedes in the southern United States have a painful bite.

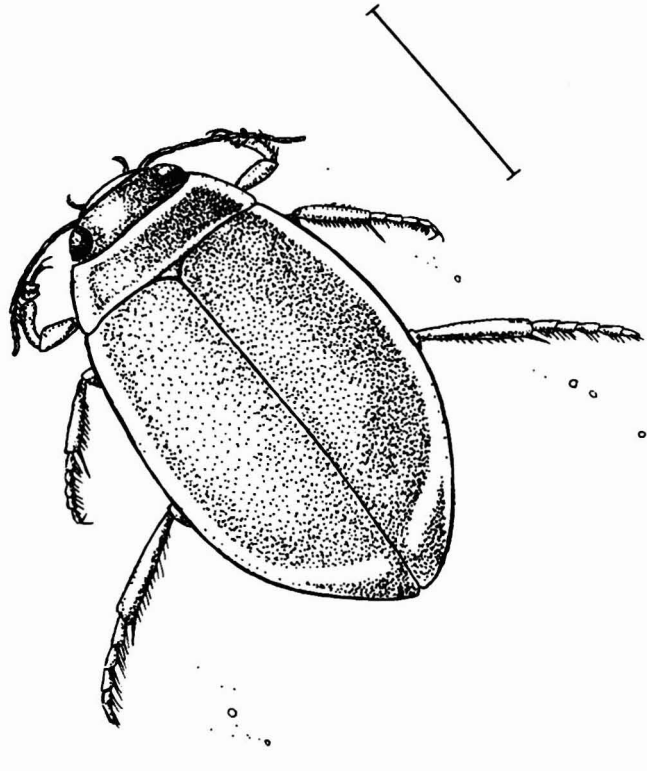
Ladybird Beetle

1. Yes.
2. Ladybird beetle; beetles (Coleoptera)
3. Almost all ladybird beetles eat other insects, primarily aphids.
4. Ladybird beetles scare away predators with their startling colors and they have an unpleasant taste.
5. Ladybird beetles feed on aphids, scale insects, and other insects that are harmful to crops. Sometimes they are brought into an area to kill insects that are eating plants. This is called biological control and is an alternative to using chemical insecticides.









Diving Beetle

1. Yes.
2. Diving beetle; beetles (Coleoptera)
3. Diving beetle adults and larvae eat aquatic animals, including insects, tadpoles, and small fish.
4. Diving beetles dive underwater and swim very rapidly.
5. Diving beetles feed on many harmful and beneficial aquatic insects, including the larvae of black flies and mosquitoes.

Leafhopper

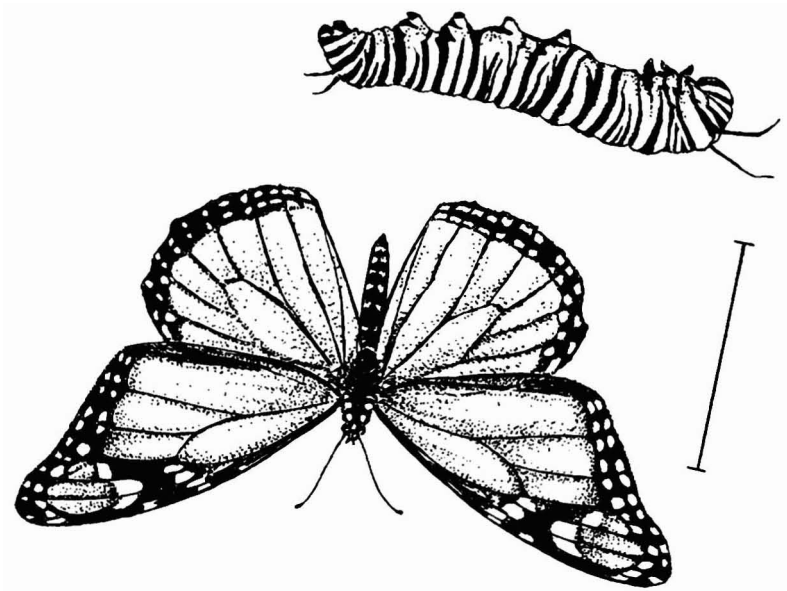
1. Yes.
2. Leafhopper; cicadas, hoppers, aphids, scales (Homoptera)
3. Leafhoppers eat plant sap.
4. Leafhoppers hop away very quickly when disturbed. They also blend in with their surroundings.
5. Leafhoppers feed on many important plants, including potatoes, grapes, peaches, alfalfa, and beets.

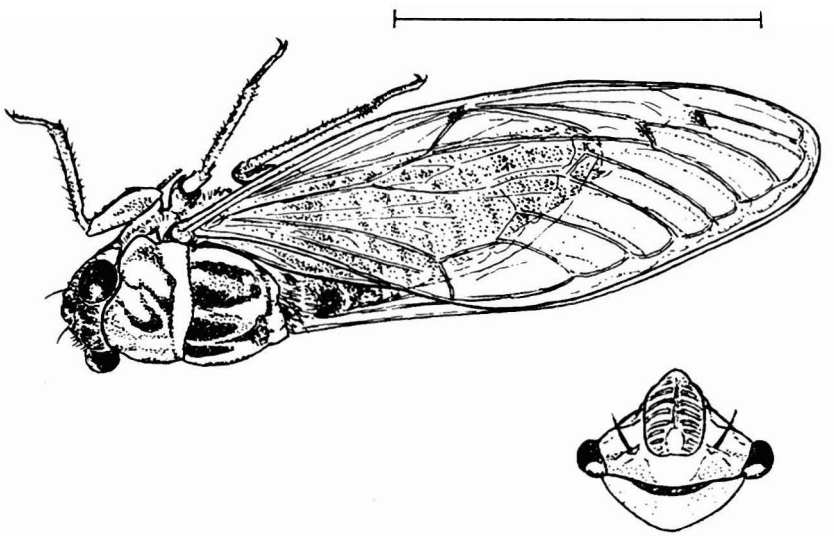
Scale

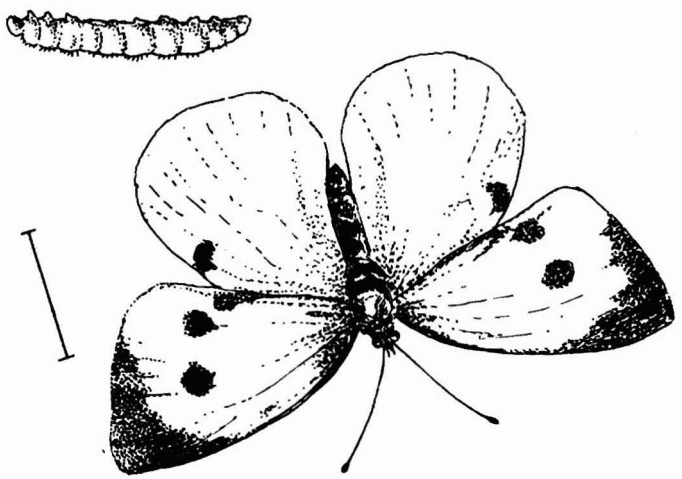
1. Yes.
2. Scale; cicadas, hoppers, aphids, scales (Homoptera)
3. Scales eat the sap of plants.
4. Scales usually secrete a protective cover, which can be hard (the oystershell scale), cottony (the cottony maple scale), or waxy (the beech bark scale, the lac scale, from which we get shellac, and mealybugs). Scales often blend in with their surroundings and do not move, making them difficult to see.
5. Several important products come from scales, including shellac. The cochineal scale produces a dye that once was commercially important. Other scales produce waxes that are used to make candles and medicine. Scales cause damage to many important crops, ornamental plants, and orchard and forest trees.

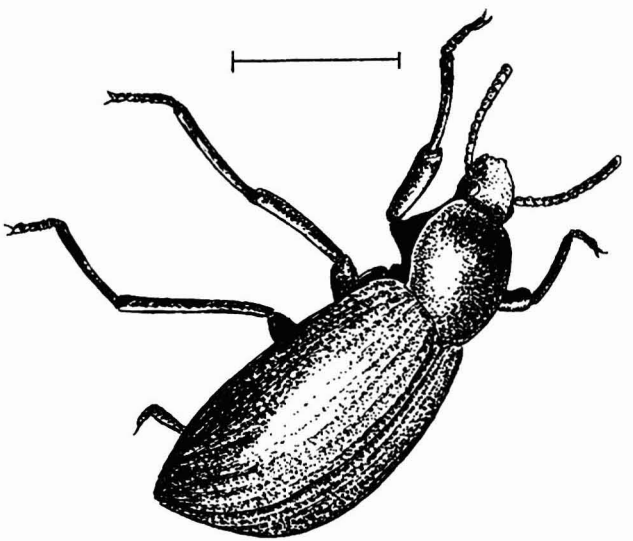
Gall Wasp

1. Yes.
2. Gall wasp; bees, wasps, ants (Hymenoptera)
3. Gall wasps feed on plant material and sap.
4. Gall wasps cause an abnormal growth to form on a plant (gall). They live inside the gall for much of their lives, where they are hidden from potential predators.
5. Although the galls of other insects, such as aphids, can harm plants, gall wasps are of little economic importance to people, neither causing harm nor bringing benefits.









Cabbage Butterfly

1. Yes.
2. Cabbage butterfly; butterflies, moths (Lepidoptera)
3. Cabbage butterfly caterpillars eat cabbages and related crops. The adults eat nectar.
4. Cabbage butterfly larvae are green and blend in with their surroundings.
5. Cabbage butterflies are important pests of cabbages and related crops.

Darkling Beetle

1. Yes.
2. Darkling beetle; beetles (Coleoptera)
3. Most darkling beetles feed on plants. Some eat mushrooms. A few feed on human foods, including flour, dried fruits, and cereals.
4. Most darkling beetles are dark colored and live in the ground. One kind raises its hind section when disturbed and runs away; it then emits a black, stinky fluid.
5. Some darkling beetles break down organic material. Others are predators of harmful insects. A few are important pests of stored foods.

Monarch Butterfly

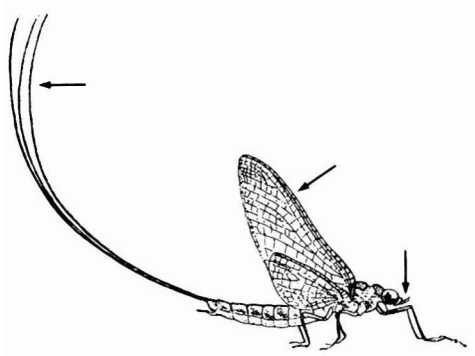
1. Yes.
2. Monarch butterfly; butterflies, moths (Lepidoptera)
3. Monarch butterfly larvae feed on milkweed leaves. The adults eat nectar.
4. Monarch butterflies have a terrible taste and are brightly colored. Predators recognize their bright colors and remember their unpleasant taste.
5. Monarch butterflies have been used in studies of migration. (One of the few butterflies that migrate, they travel from the northern United States and southern Canada to the southern United States and Mexico.) The monarch butterfly has been nominated to be our national insect.

Cicada

1. Yes.
2. Cicada; cicadas, hoppers, aphids, scales (Homoptera)
3. Cicadas eat tree sap.
4. Some species of cicada adults emerge from the ground only once every thirteen or seventeen years. Then there are so many cicadas that predators are not able to eat them all. Immature cicadas hide in the ground.
5. Cicadas lay their eggs on the twigs of young trees, often killing the twigs.

Important In

Mayflies (Ephemeroptera)

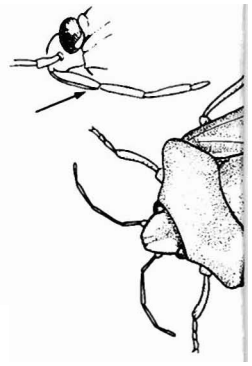


mayfly

The wings have many veins, which make a netlike pattern; the abdomen has three (sometimes two) long cerci, or "tails"; the antennae are short. Mayflies are commonly found in and around water.

The Latin name comes from the word *ephemeral,* meaning short-lived, and refers to the fact that the adults live only a day or two.

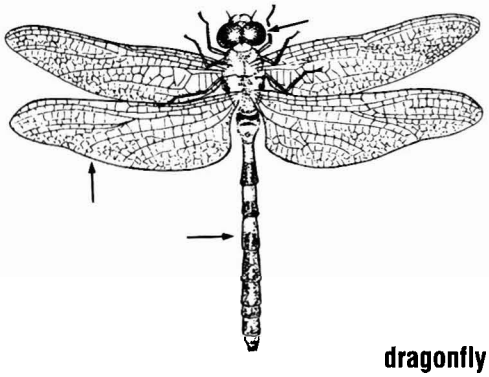
True bugs (Hem



The front wings are
tips, and overlap to fo
form tubes for sucki

The Latin name mea
and refers to the fac
front wing is hard a

Dragonflies, damselflies (Odonata)



dragonfly

The wings and body are long and narrow; the eyes make up most of the head. Dragonflies and

Butterflies, moths (L

The wings have scales tha
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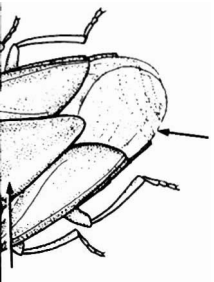
(Note: It is best not to han

The Latin name means

sect Orders

iptera)



stink bug

hard at the base, soft at the
rm triangles; the mouthparts
ng.

ns half (*hemi*) wings (*ptera*)
t that the bottom half of the
d the top half is soft.

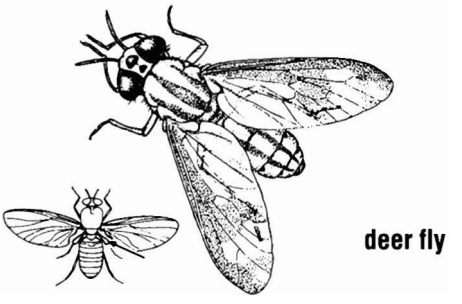
epidoptera)

ecropia moth

t come off like dust on
nsects are handled.
dle these insects.)

scale (*lepido*) wings

Flies (Diptera)

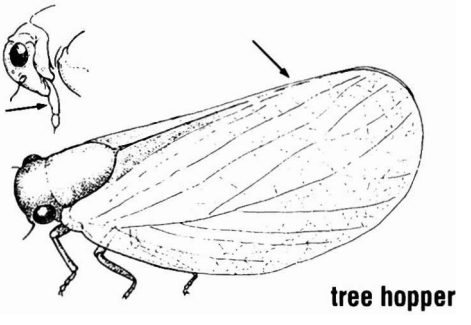


deer fly

Flies have one pair of front wings; there are small "knobs" in place of hind wings.

The Latin name means two (*di*) wings (*ptera*)

Cicadas, hoppers, aphids, scales (Homoptera)



tree hopper

The mouthparts form tubes for sucking; the wings may be absent (scales and aphids) or folded like a roof over the body (cicadas and hoppers). These insects are plant feeders.

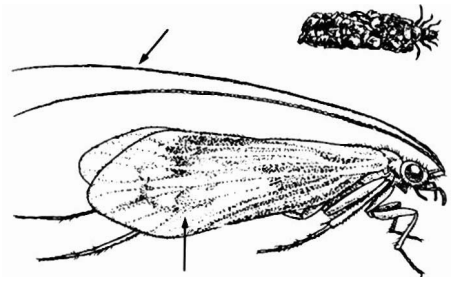
The Latin name means alike (*homo*) wings (*ptera*) and refers to the fact that the front wings have a uniform texture.

Lacewings (Neuroptera)

commonly found in and around water.

The Latin name comes from the Greek word for tooth (*odon*) and refers to the mouthparts.

Caddisflies (Trichoptera)

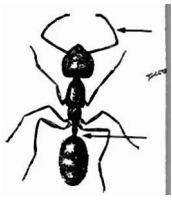


caddisfly

The wings are hairy; the antennae are long. The larvae often build protective cases to live in. Caddisflies are found in and around water.

The Latin name means hair (*tricho*) wings (*ptera*).

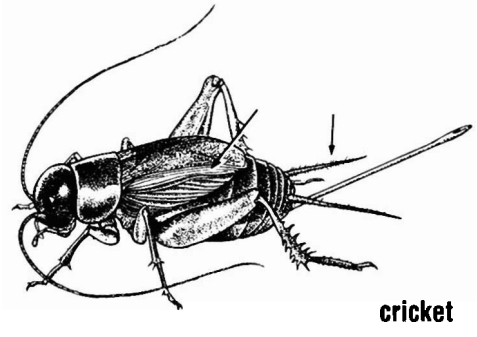
Bees, wasps



The waists of so
long. Bees and
wings.

The Latin name
wings (*ptera*) a
and hind wings

Grasshoppers, crickets, walking sticks, mantids, cockroaches, rock crawlers (Orthoptera)

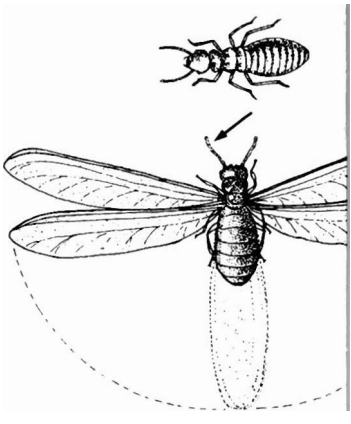


cricket

The wings may be well developed (grasshoppers, crickets), small, or absent (walking sticks); their cerci, or "tails," are usually well developed. Most are plant feeders.

The Latin name means straight (*ortho*) wings (*ptera*).

Termites (Isoptera)



The wings may be absent; t
the bodies are soft and usu
antennae resemble string
live in groups.

The Latin name means equ
and refers to the fact tha
wings are the same size in

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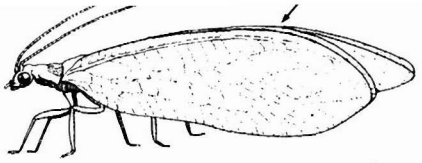


lacewing

The wings have many veins, which make them look like lace; the antennae are usually long; the bodies are soft. Most lacewings are predators.

The Latin name means nerve (*neuro*) wings (*ptera*) and refers to the many veins on the wings.

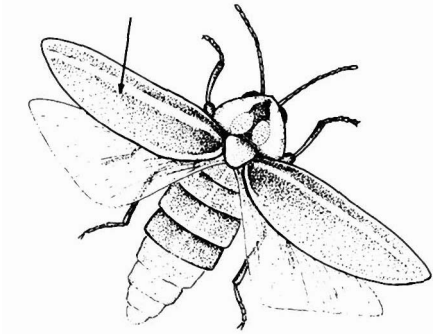
ants (Hymenoptera)

wasp

ne are narrow; the antennae are
asps have wings. Ants have no

eans god of marriage (*hymeno*)
d refers to the fact that the front
re joined by a row of tiny hooks.

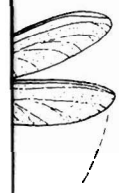
Beetles (Coleoptera)



lightningbug beetle

The front wings are hard and form a protective sheath.

The Latin name means sheath (*coleo*) wings (*ptera*).

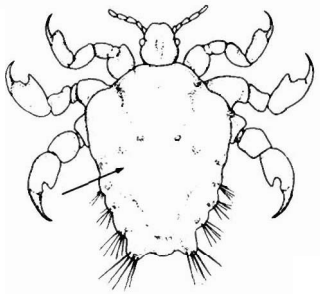


termite

eir waists are broad;
lly light colored; the
of beads. Termites

al (*iso*) wings (*ptera*)
the front and hind
many species.

Sucking lice (Anoplura)



sucking louse

They have no wings; the body is flat. Sucking lice are parasites of mammals.

The Latin name means unarmed tail.