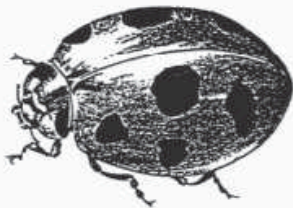
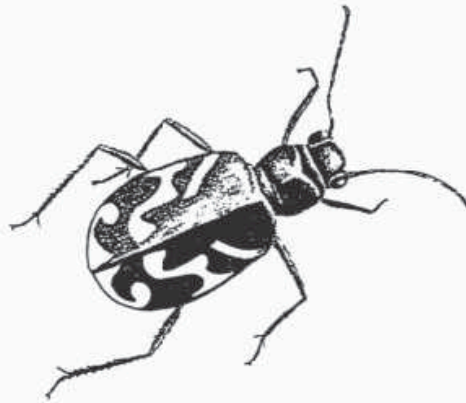




# 4-H Entomology Project Leader Guide

Grades 4-6



Oregon State **OSU** Extension  
UNIVERSITY Service

4-H 3221L  
Revised December 2015

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## ABOUT OREGON 4-H ENTOMOLOGY

The development of this 4-H Entomology Education Project is driven by two basic principles:

1. Learning about insects can be fun. The project provides simple and inexpensive, yet fun activities that teach youth about insects and their environment.
2. 4-H volunteer teaching activities must be easy-to-use. This project includes learning activities in an easy-to-use format. It was designed to be teacher friendly and takes the guesswork out of teaching the subject.

### GRADE LEVEL

This project was developed for youth in grades 4th through 6th. Both group and individual activities encourage participation. Leaders are encouraged to select learning activities that are most suitable to their youth. The overall intent is to facilitate learning and to spark excitement in both adults and youth.

### CONTENTS

- Leader's Guide - This three-ring notebook contains a complete, easy-to-read outline for lessons.

Each lesson provides a variety of activities that can be conducted depending on the time available. The following are a mix of games, experiments, and field work that help to teach the basic principles and concepts in each lesson.

## WHAT IS ENTOMOLOGY?

Entomology is the study of insects. There are many ways to learn about insects. Study could include reading, observing live insects, or working with collections of dead insects.

In reading about insects you can learn about an insect's life stages, habits, food, where and how they live.

Books cannot convey the excitement of watching live insects in their natural environment. Live insects can be reared in cages, in covered potted plants, or with other food sources. Accurate recorded observations are more important than casual collecting.

Young people are usually fascinated by insects and insect study is a way for them to learn more about insect types, life cycles, behaviors, habitat and relationships with humans.

Insects are a very important group of animals. There are more insects in the world than all other animals combined. It has been estimated that the total insect population of the earth is around  $10^{18}$  individuals (that's 1,000,000,000,000,000,000!)

Insects have inhabited the planet for at least 300 million years. We know this because of the fossil records that insects have left behind.

Most of the millions of insect species are beneficial. Insects are a major food source for many animals, and they also help break down and recycle dead plants and animals. In addition, most flowering plants require insects for pollination. Insect pollination activities provide us with billions of dollars of fruits, vegetables and other foods.

Some beneficial insects help control other destructive insects. Many wasps and some flies act as parasites of harmful insects. Lacewings, some beetles and mantids are predators of aphids and other destructive insects.

Insects also produce useful materials, like honey, silk, dyes, shellacs and food. Insects make the world a more interesting place. Delicate butterflies, colorful beetles, the chirping of crickets, the buzzing of bees are all familiar sounds.

Activities in this book are to be used as guides. You may substitute alternate projects. The entomology project fits well with other projects such as plant and animal science, forestry or animal husbandry. Whatever your involvement in time or effort, it will be worthwhile.

## **LESSON PROFILES**

A brief description of the eight Entomology lessons:

### ● **LESSON 1 - EXTERNAL ANATOMY**

The study of external anatomy helps develop an understanding of the physical characteristics of insects. What are their body parts? Where are the parts located on the body? This knowledge becomes important when learning to classify and identify different insects.

### ● **LESSON 2 - INSECTS AND THEIR RELATIVES**

The class Insecta belongs to a large group of animals called *Arthropods*. Five other classes of Arthropods are similar to insects in physiology, shape and behavior. It is important to distinguish insects from their similar small relatives.

### ● **LESSON 3 - HOW INSECTS GROW**

Insects go through several stages of life. Most change shape (form) as they develop. The process of changing form is call metamorphosis. Being able to identify the different stages in the life cycle is important for identification, rearing, or control.

### ● **LESSON 4 - HOW INSECTS ARE CLASSIFIED**

Once youth learn to recognize insects from other Arthropods the next step is to distinguish between different types of insects. Knowing the different orders of insects gives insight to their environment and behavior.

### ● **LESSON 5 - WHERE TO COLLECT INSECTS**

Insects can be found just about everywhere on the earth. Collecting in varied habitats throughout the year will enable the youth to increase the diversity of their collection. Youth will also learn about the diverse environments in which insects can survive, their food habits and behavior.

### ● **LESSON 6 - HOW TO COLLECT INSECTS**

Since insects can be found in the air, water, soil, on plants or animals or in buildings, several techniques must be used to collect them. This section shows the different techniques used to collect insects from different habitats.

### ● **LESSON 7 - PROGRAM FOR CLUB MEETINGS**

This lesson gives the volunteer leader some ideas on what to discuss, or demonstrate at club meetings. The topics per meeting are designed to progress through the 4-H year as are the above lessons. More time may be needed for certain subjects and may take longer than one club meeting to accomplish. Flexibility is the key to these lessons and project.

## ● LESSON 8 - MATERIALS NEEDED FOR COLLECTING INSECTS

This lesson is an accumulation of Fact Sheets on "How To Make" the materials needed for the entomology project. The single sheets are designed to be removed from this handbook, copied, and distributed to each 4-H club member. The Fact Sheets should be included in club work or taken home.

## REFERENCES

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4th - 6th grade

**PURPOSE**

To develop an understanding of the physical characteristics of insects.

**OBJECTIVES**

Youth will be able to:

- ◆ identify the external parts of an insect
- ◆ describe shapes and colors of insects
- ◆ list physical characteristics of insects
- ◆ describe different insect mouthparts

**LESSON TIME**

Lesson time will vary upon learning activities selected. Lesson activities also vary depending upon members and ages of youth. Most activities are approximately 30 to 45 minutes.

**LEARNING ACTIVITIES**

Build a Grasshopper  
Insect Tree  
Insect Models  
Amazing Insect Mouths  
Activity Ideas for External Anatomy

**ADVANCED PREPARATION**

- ◆ Review EXTERNAL ANATOMY Background Information
- ◆ Review each activity and determine choices for your club meeting
- ◆ Collect and prepare, or ask youth to collect and prepare materials for appropriate activities.

## BACKGROUND BASICS

Insects are small animals that belong to a large group (phylum) of animals called *Arthropods*. Arthropods include cray fish, spiders, millipedes, centipedes, ticks, mites, and similar creatures. Arthropods have jointed legs and bodies that are segmented. Insects are one group (class) of arthropods.

Below are some of the characteristics that are common to the class **Insecta**:

**Small size:** Most insects are very small compared to birds, mammals, reptiles and fish. Insects range in length from about 1/100th of an inch (.025 cm) to over 13 inches (32.5 cm).

**Exoskeleton:** Insects have an external skeleton (a hard outer covering called an *exoskeleton*). It helps protect their internal organs and also helps prevent their drying out. The exoskeleton is made up of layers. The outside layer is waxy and acts like a waterproof raincoat. Underneath this layer is a tough, armor-like layer. The exoskeleton also acts as an anchor for insects' muscles.

**Body parts:** Insects have three main body parts - the *head*, the *thorax*, and the *abdomen*. With some insects it is almost impossible to tell when one part starts and another stops. Here's an easy way to tell which part is which:

- \* the *head*: holds the eyes, mouth and antennae.
- \* the *thorax*: where the legs and wings are attached.
- \* the *abdomen*: that part behind the thorax (what's left). It contains the digestive and reproduction systems.

**Legs:** Insects have six jointed legs (three pairs). One pair is attached to each segment of the thorax. (The thorax has three segments.)

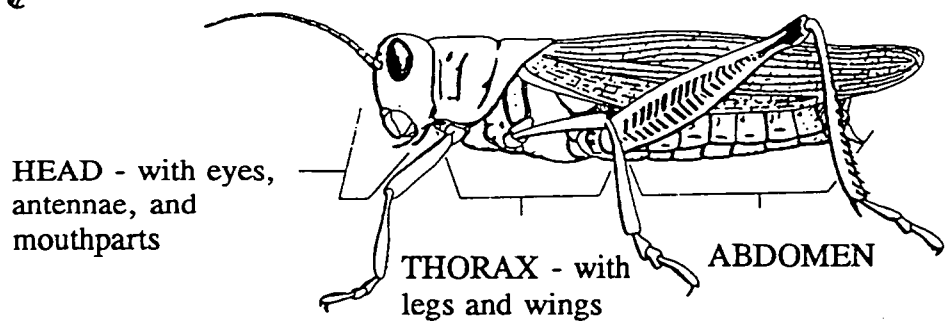
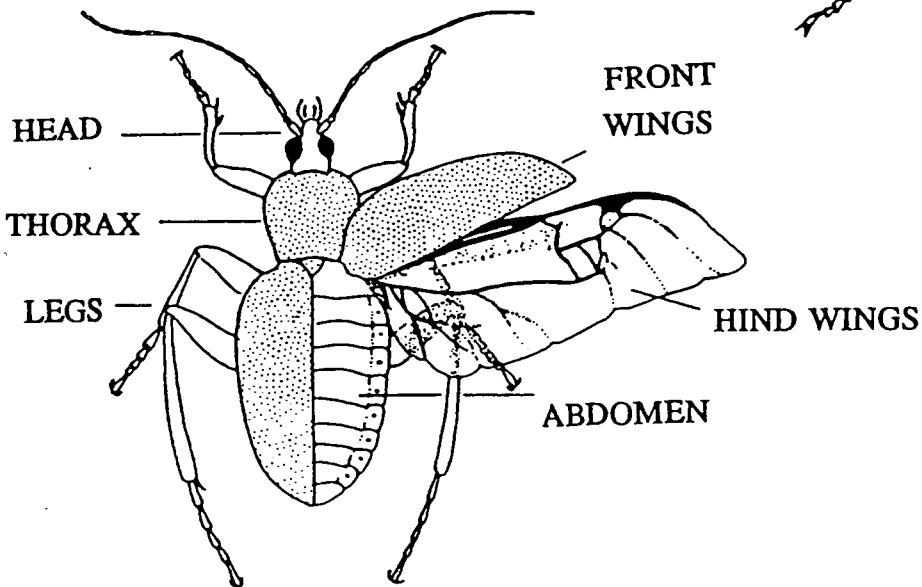
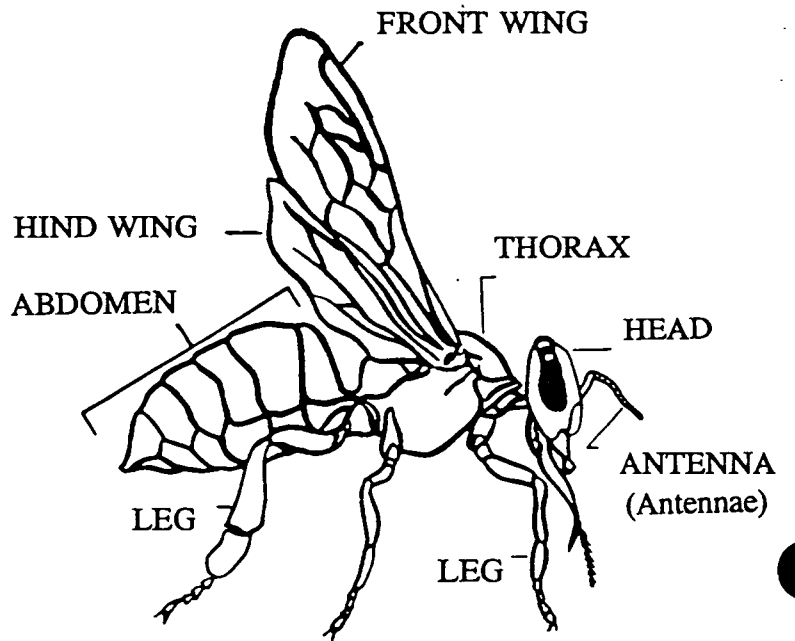
**Wings:** Insects are the only invertebrates (animals without backbones) that can fly. Insects can have 0, 1 or 2 pair of wings. Only adult insects have wings.

**Eyes:** Most insects have two types of eyes: **simple** and **compound**. The compound eye is the largest, made up of thousands of tiny lenses that fit closely together. Each lens forms one tiny picture, together they form a mosaic composite of the world around the insect.

This mosaic picture is not very sharp and lacks detail. However, the more lenses in the compound eye the better the insect can see. Dragonflies have the best eyesight, some having over 25,000 lenses in each eye. Houseflies have over 4,000. Compound eyes can recognize color, and pattern, and are sensitive to movement.

**Antennae:** Insects have two antennae (one pair) attached to the head. Antennae are used to feel, smell, touch and sometimes hear. Antennae differ in size, shape and how they are used.

### Body Parts Of An Insect



**OBJECTIVES:** For youth to:

- construct an insect and
- label the body parts

**MATERIALS:**

- copies of Build a Grasshopper
- pencils and crayons
- construction paper
- rulers
- glue

**TIME:** 30 minutes to cut out squares, glue to paper, label parts.

This "parts chart" activity is a good way to introduce or review the parts of an insect. First give each person a copy of the grasshopper squares. Have the group follow the directions for building a grasshopper by cutting out all of the squares, pasting them in place on another sheet of paper, and labeling the parts according to the sample on their Copycat Page. For a neater chart, have them use a ruler when labeling.

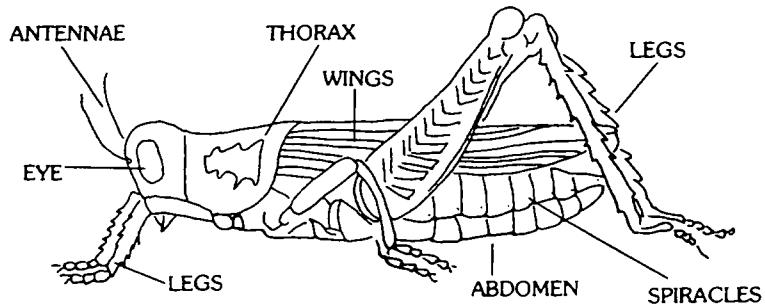
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**LIVE HOPPERS**

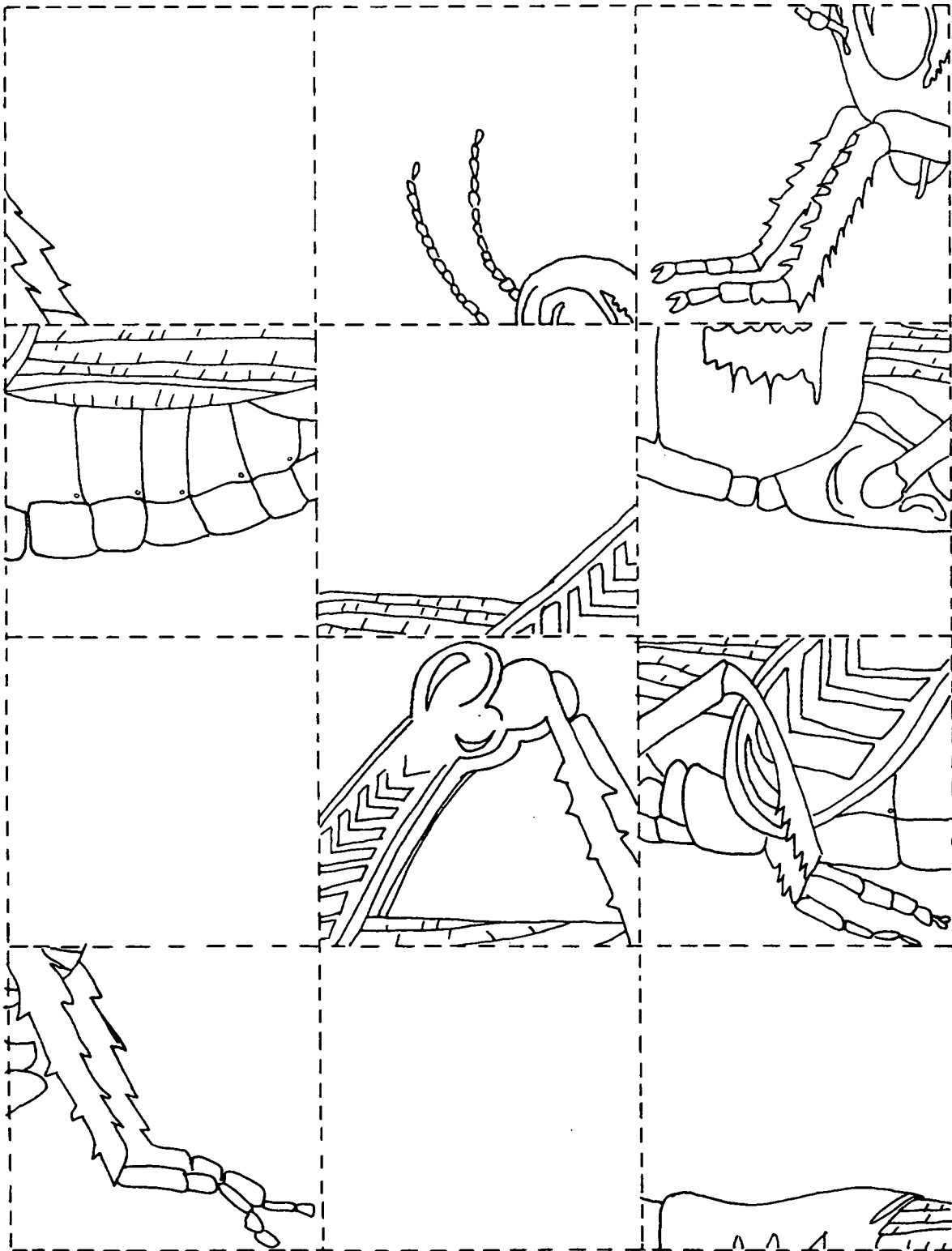
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Before or after you do this activity, it would be great if the group could watch a live grasshopper in action. They'd get a chance to see how the legs work, how the wings fold back over the abdomen, how the compound eyes look close up, where the mouth is, and how the grasshopper breathes. (Check Lesson 6 for ways to catch insects. And be sure to release the grasshopper where it was found.)





Turn this mixed-up insect into a grasshopper! Cut out the pieces along the dotted lines and glue them together to make a grasshopper. Then label these parts: HEAD, THORAX, ABDOMEN, EYE, ANTENNAE, LEGS, WINGS, and SPIRACLES. Here's what it should look like when you're done.



**OBJECTIVES:** For youth to:

- describe insect shapes and colors

**MATERIALS:**

- copies of insect pictures
- crayons, markers, colored pencils
- construction paper
- hole punch
- glue
- yarn
- clay
- tree branch

**TIME:** 1 hour to cut, color, glue pictures.

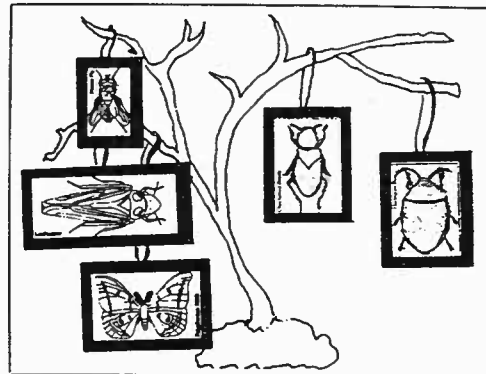
**SUGGESTION:**

Plan a hike to search for branches. This is a good time to study habitats of insects.

Here's a great way to make an "indoor" insect collection. Give each person a copy of the insect picture pages. Have them color the insects with crayons, colored pencils, or markers. To find out what colors to make the insects, look up each insect in a field guide. (See bibliography for a list of common guides.)

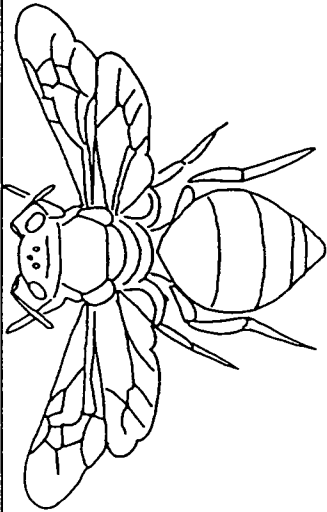
After the insects are colored, paste the page to a sheet of colored construction paper. Then have them cut out each insect and its name, as shown, and punch a hole in each cut-out.

Have each person collect a small dead tree branch and place the base of the branch into a piece of soft clay. To finish their insect trees, have them tie each insect to a different twig with yarn.

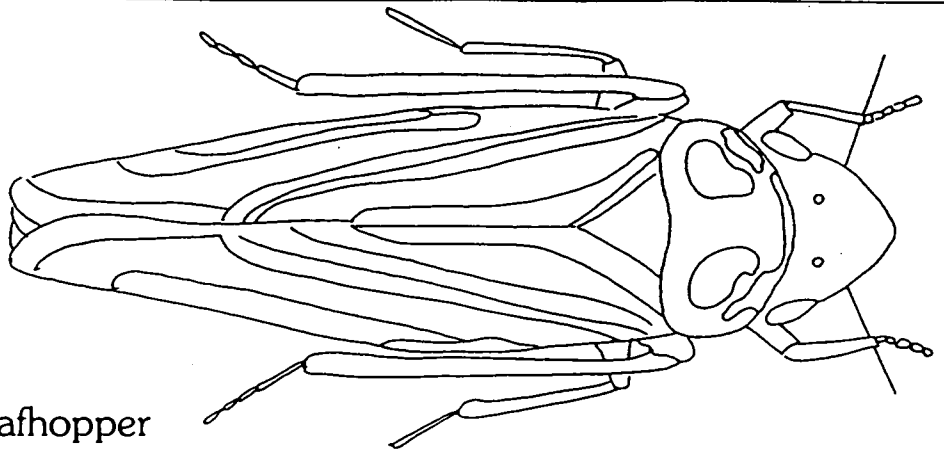


If you would like to have one tree for the whole group you can bring in a large branch and give each child one insect to look up, color, and attach to the tree.

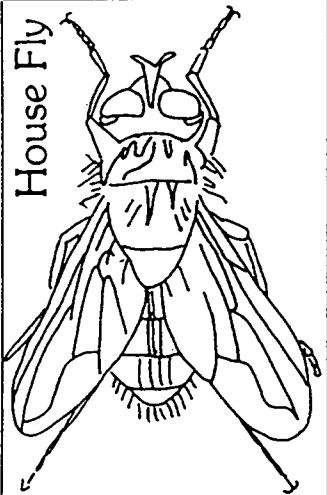
# INSECT PICTURE PAGES



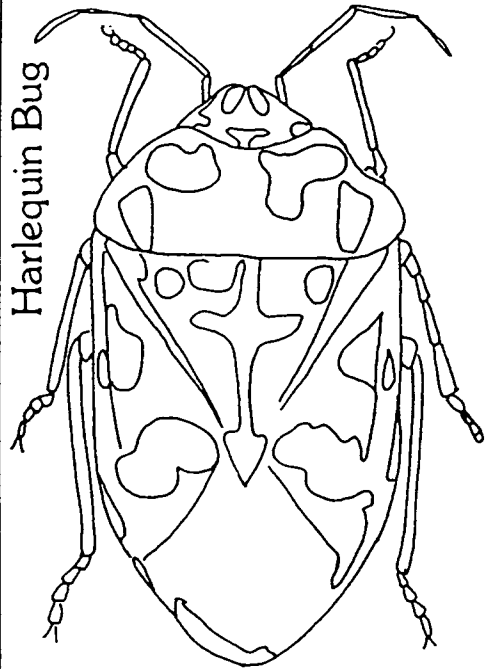
Halictid Bee



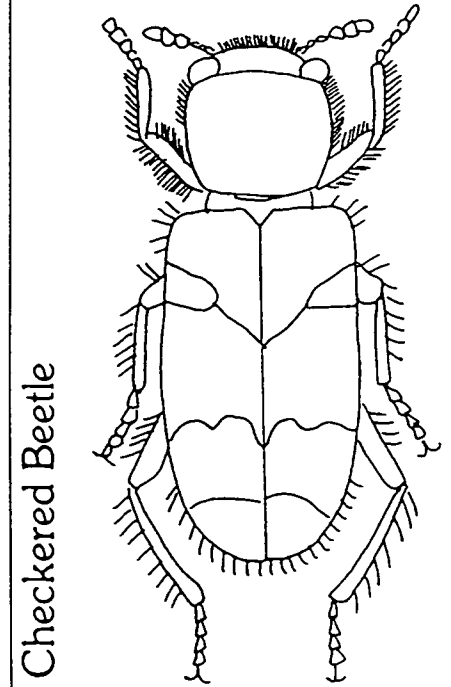
Leafhopper



House Fly

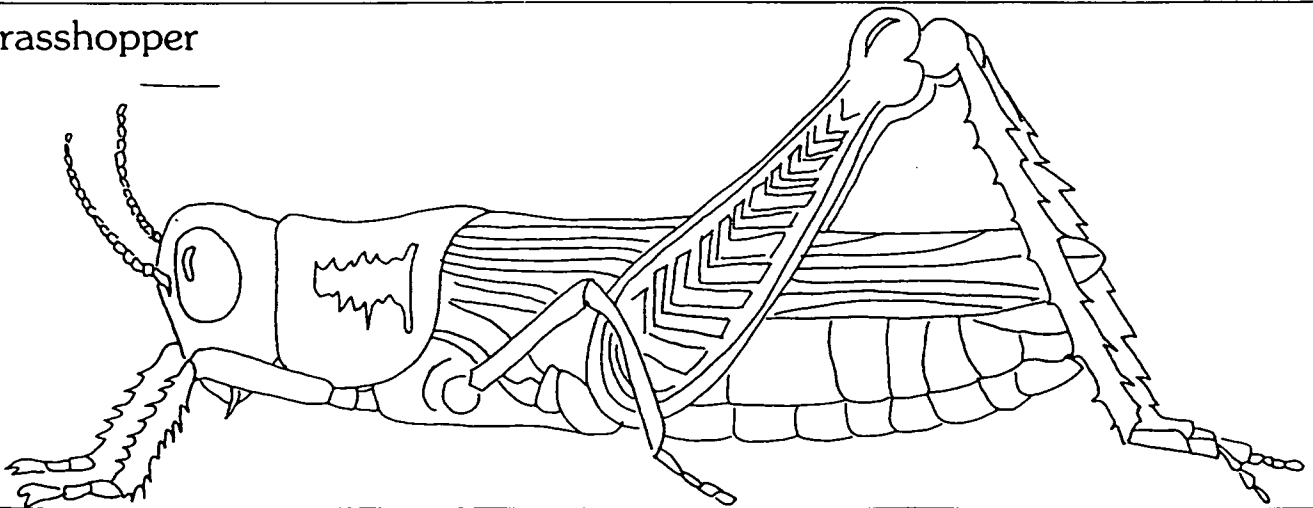


Harlequin Bug

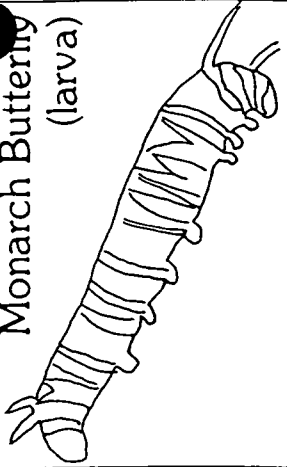


Checkered Beetle

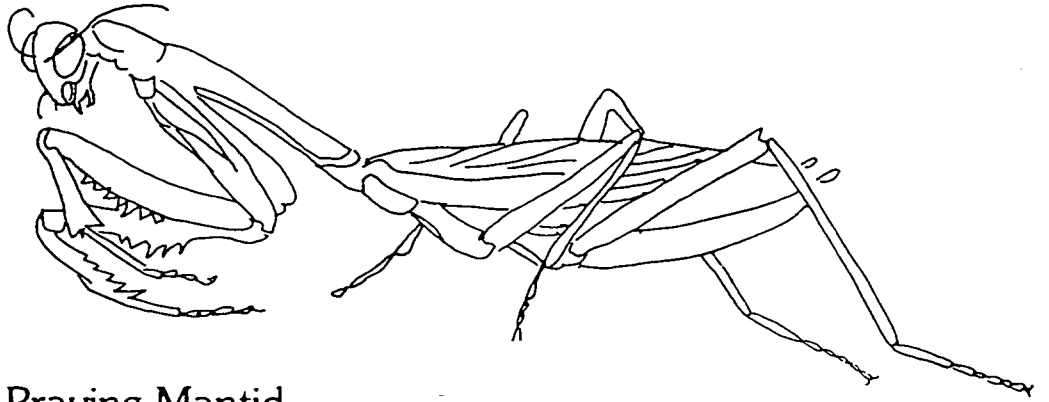
Grasshopper



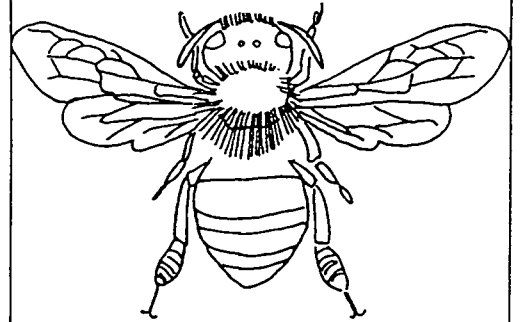
Monarch Butterfly  
(larva)



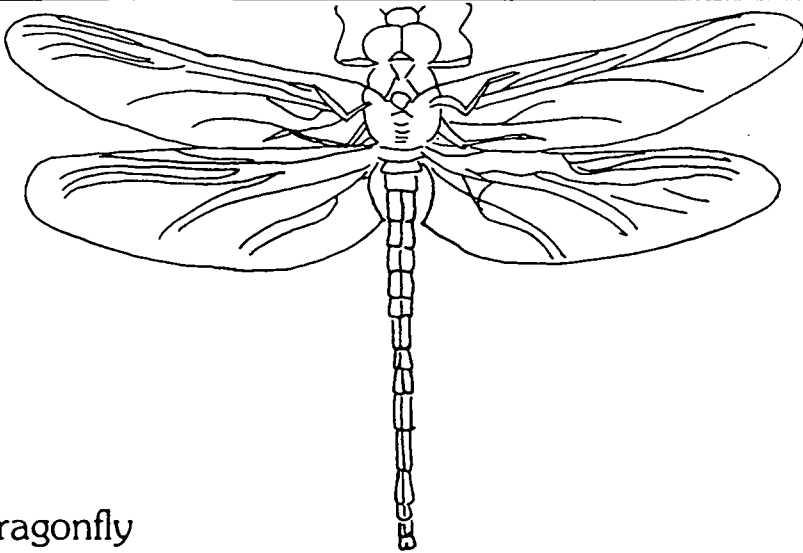
Praying Mantis



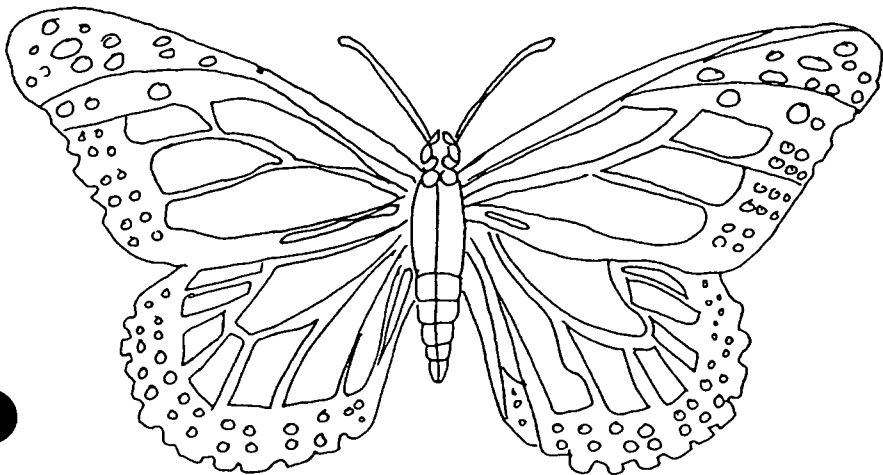
Honey Bee



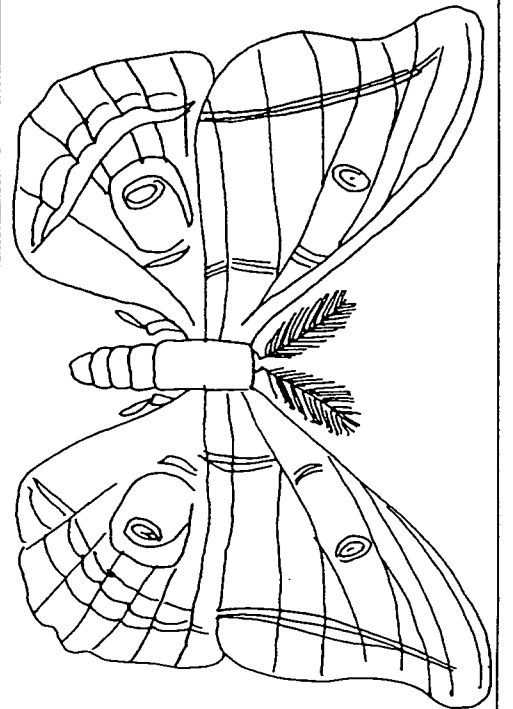
Dragonfly



Monarch Butterfly



Polyphemus Moth





**OBJECTIVES:** For youth to:

- describe different insect mouthparts
- demonstrate how mouthparts work

**MATERIALS:**

- large pictures of house fly, grasshopper, mosquito, butterfly or moth
- pliers, toy syringe and sponge
- clear drinking glass or beaker
- food coloring (any color)
- enough soda straws for groups
- enough milk or juice for group

**TIME:** 30 minutes to demonstrate different mouthparts and youth to do activity.

If you were to compare a beetle's mouth to a butterfly's mouth, you'd see a big difference. Beetles have *chewing* mouthparts and butterflies have *sucking* mouthparts. Insects have different types of mouthparts because they feed on different types of food. In this activity, your group will be able to see that insects have different kinds of mouthparts and each type of mouth works in a different way.

Begin by asking your group some questions about how insects eat. For example, ask if insects have teeth. (Lots of children may say yes, since they may have been "bitten" by an insect). Explain that insects don't have teeth as people and many other animals do. But many do have sharp jaws for tearing and chewing food.

Then ask if all insects eat the same things. (Different insects eat many different kinds of food such as blood, leaves, nectar, dead animals, manure, fungi, and wood, just to name a few. And to eat these foods, insects have developed different kinds of mouthparts).

Next, hold up pictures of a grasshopper, house fly, mosquito, and butterfly and explain that each of these common insects has a different type of mouthpart. Then compare each of these insect mouths with the following tools and household items to demonstrate how each mouthpart works:

\* A grasshopper's mouthparts work something like *pliers* to tear and chew plants. Their jaws move sideways, not up and down as people's do. (Hold the pliers sideways and work them back and forth).

\* Female mosquitoes use their needle-like mouthparts to draw up blood in much the same way as a doctor uses a *needle and syringe*. (Put a syringe into a glass or beaker containing colored water and draw some of it up. Use food coloring to color the water).

\* A house fly's mouthparts work like a *sponge* to soak up liquids. (Pour out a little water and sop it up with a sponge).

As a nice ending to your discussion, let the group discover for themselves how butterflies and moths feed. Pass out straws and milk or fruit juice to each person. As you hold up a picture of a butterfly or moth, talk about how these insects often feed on nectar from flowers. Explain that the long, tongue-like mouthparts of many butterflies and moths are used as a straw would be to sip up the nectar. Now have your kids pretend to be butterflies and moths as they sip up their juice or milk "nectar".

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"Reprinted with permission of National Wildlife Federation from the *Incredible Insects* issue of *NatureScope*, copyright 1989.

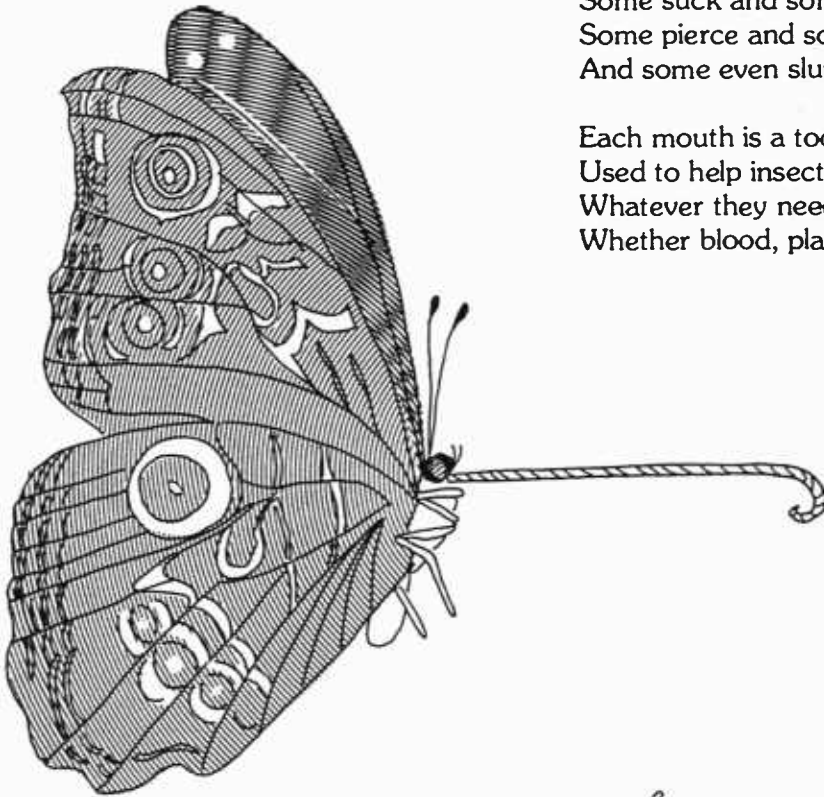


Insect mouths are amazing:  
Some suck and some chew,  
Some pierce and some sponge,  
And some even slurp goo.

Each mouth is a tool  
Used to help insects eat  
Whatever they need,  
Whether blood, plants, or meat.

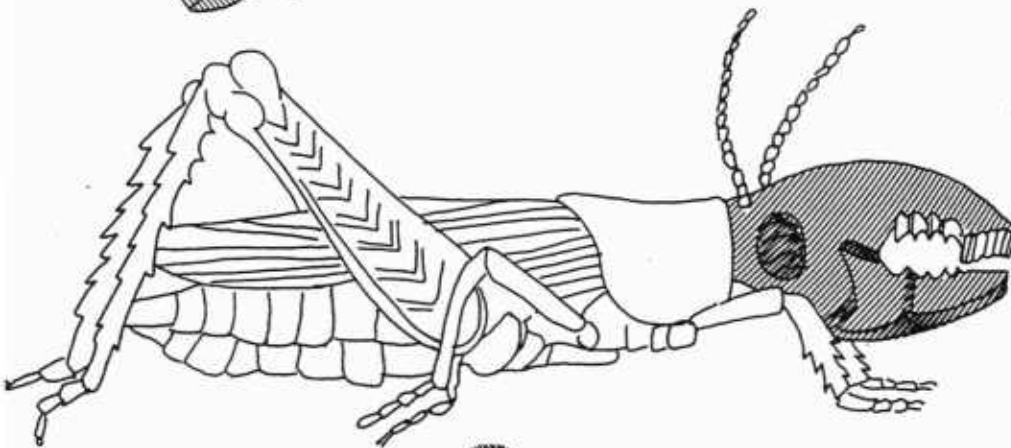
We've picked out three insects  
Described all their foods,  
Then drawn them as tools  
Or as things people use.

Can you guess what they are  
From the verses below?  
(All three crazy insects  
Are ones that you know.)



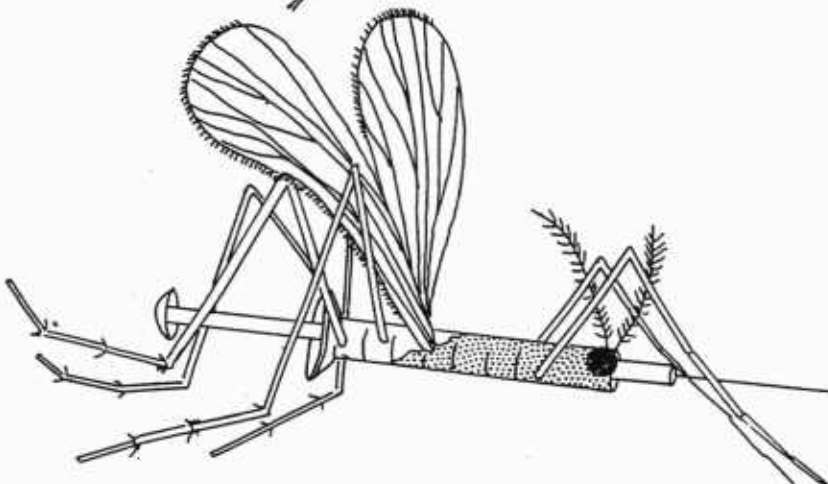
1. My body is covered with  
Scales, not with skin;  
My mouth's like a straw,  
Round, long, and thin;  
I unroll this neat "tongue"  
From under my chin.  
Then I suck up some nectar  
And roll it back in.

I am a \_\_\_\_\_



2. You'll find me in fields  
'Cause it's leaves that I munch.  
And if you should grab me  
I'll spit up my lunch.  
My jaws are like pliers  
To chew, tear, and crunch,  
And sometimes I'm a problem  
'Cause I eat such a bunch.

I am a \_\_\_\_\_



3. My mate sucks up nectar,  
But I go for blood.  
I'll get you in swamps  
When you're tromping through mud.  
My mouth's like a needle,  
As sharp as a pin,  
And I'll suck up your blood  
Through a hole in your skin.

I am a \_\_\_\_\_

**OBJECTIVES:** For youth to:

- make an insect with all the external parts

**MATERIALS:**

- modeling dough
- arts and crafts scraps
- acrylic or tempera paints and brushes
- food coloring (optional)
- insect field guides (optional)

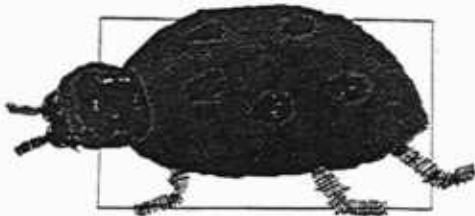
**TIME:** 1 hour to set up, distribute materials, demonstrate. (2-3 days drying time.)

**SUGGESTION:** Make dough ahead of time.

Before starting, show pictures of adult insects and discuss the characteristics that make insects. Now give each child a lump of modeling dough and put the other materials in piles around the room. Have them roll and mold the dough into a head, thorax, and abdomen. They can use a toothpick to carve lines or dots on the insect's body and make eyes, wings, and legs with dough. You may want to have them try using pipe cleaners or twigs for legs and antennae, wax paper or plastic wrap for wings, and beans for eyes.

With younger kids, try making fantasy insects. Divide the dough into balls and add food coloring to make green, yellow, orange, blue and red dough. Give each of the children a little lump of each color and let them design their own insects.

Older children can try to make realistic models. Have them each choose an insect to model from a field guide or textbook. Give them white dough and have them mold their insects into shape. When the models are dry (2-3 days), they can paint them with acrylic or tempera paints to resemble the real insects.



vanilla or peppermint flavoring  
(to make it smell nice)

Cook over medium heat, stirring until the mixture starts boiling or forms a ball (about 2-3 minutes). Remove from the heat and let cool until it can be handled.

To make the dough, mix the following ingredients in a saucepan:

- 2 cups flour
- 2 tablespoons oil
- 1 cup salt
- 2 cups water
- 4 teaspoons cream of tartar

Knead the dough like bread until smooth and supple. To store the dough, keep it in a plastic bag in a cool place. (Makes enough for 6-8 kids).

**OBJECTIVES: To:**

- provide more activity ideas for club meetings

**MATERIALS:**

- listed per idea

**TIME:** depends on the activity and age of group

1. Make "model" insects out of household materials like construction paper, felt, pom-poms, cotton balls, styrofoam balls and shapes, bottle caps, pipe cleaners, buttons, glitter, walnut shells, clothes pins, etc.
2. Use large rubber insects (available from toy/novelty stores) to illustrate insect body structures. These "bugs" are easily handled by children of all ages. See how many structures the students can identify. Are there any incorrect features on the rubber insects? If so, what's wrong.
3. Use pictures from insect books, magazines, or pesticide brochures to discuss the following:
  - \* What types of mouthparts, legs and wings can they find?
  - \* Why do some insects have chewing mouthparts and others have piercing-sucking mouthparts? (Hint: what kind of food do they eat, solid or liquid?)
  - \* Why do they think insects have such a wide variety of leg and wing types? (Hint: these are usually modified to suit the insect's special way of life.)
4. Name the parts - make some simple diagrams of insects and have the students identify the important body parts. (Play "pin the tail on the insect." What area they do hit they need to identify. Give points for the correct answer.)
5. Have the students play the "bug body swap" game. You will need a small collection of insect pictures (simple drawings or sketches will do). There should be at least two pictures for each type of body part (chewing mouthpart & siphoning mouthpart, elbowed antenna & thread-like antenna, walking leg & swimming leg, membranous wing and scaly wing, etc.). You will need enough pictures so that each student has two pictures. Ask the students to sit on the floor in a circle. As you call out the name of a body part, the students who have those pictures should change places with one another. Then call out another body part. Play until each student has had at least one turn.
6. Play relay games. The object of the game, to answer correctly the part of the insect pointed to by a moderator. Points would be given for the correct answers, etc.

**PURPOSE**

To identify the six classes of Arthropods. To know the basic characteristics of each class and distinguish between the classes.

**OBJECTIVES**

Youth will be able to:

- ◆ identify the six classes of arthropods
- ◆ describe the physical characteristics of each class of arthropod
- ◆ distinguish between the six classes of arthropods by physical characteristics

**LESSON TIME**

Lesson time depends upon the learning activity selected. The time can vary between 10 minutes to a whole club meeting.

**LEARNING ACTIVITIES**

Circle the Insect  
Eight Legs or Six - Picture Postcards  
Activity Ideas for Insects and Their Relatives

**ADVANCED PREPARATION**

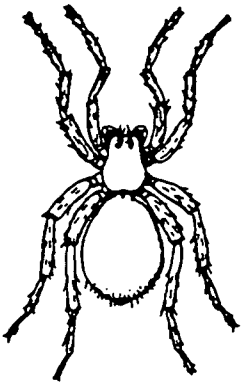
- ◆ Review insects and their relatives background basics information
- ◆ Review each activity and determine choices for the age groups of youth
- ◆ Collect and prepare materials or ask youth to collect and bring materials

BACKGROUND BASICS

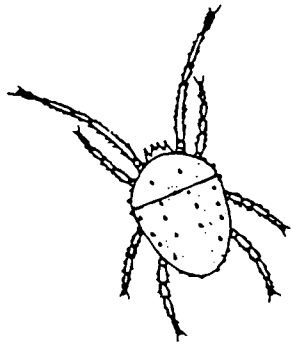
The group (Phylum) of Arthropods has six classes: Arachnida; Chilopoda; Crustacea; Diplopoda; Symphyla; and Hexapoda or Insecta. Lesson 1 studied the characteristics of the insect class. This lesson shows pictures and descriptions of all six classes of Arthropods. It's important to distinguish what is an insect and what is not.

Arthropods

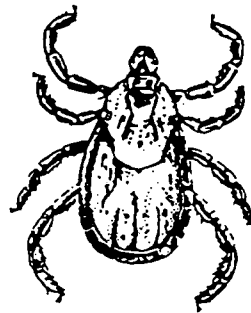
1. ARACHNIDA (uh-rack'-nida) Harvestman, Chiggers, Scorpions, Pseudoscorpions, Spiders, Mites, Ticks



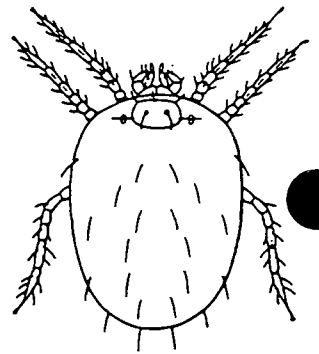
Spider



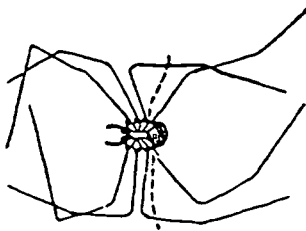
Mite



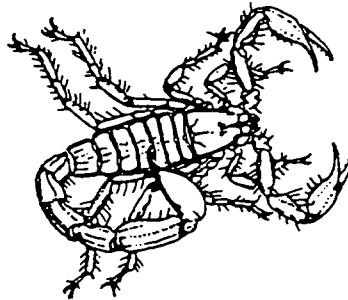
Tick



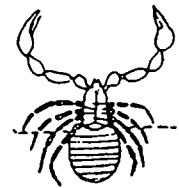
Chigger



Harvestman



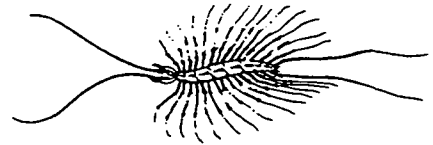
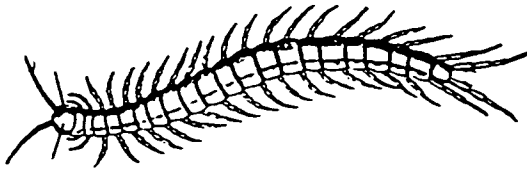
Scorpion



Pseudoscorpion

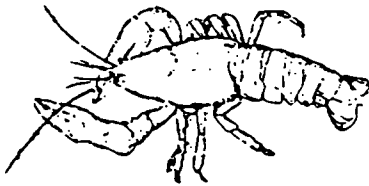
Two body regions (head and thorax combined into one region). No antennae. Four pairs of legs.

2. **CHILOPODA** (ki'-low-poda) Centipedes

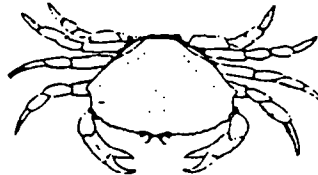


Generally flattened, many segmented, long bodied animals. One pair moderately long antennae. One pair of legs to each body segment. Usually swift runners, inhabiting the soil.

3. **CRUSTACEA** (crus-tay'-sea-uh) Crayfish, Shrimp, Crabs, etc.



Crawfish



Crab



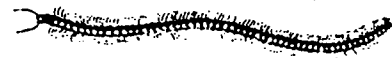
Shrimp



Sowbug

Head and thorax combined into one part. Some have two pairs of antenna. At least five pairs of legs. Aquatic respiration.

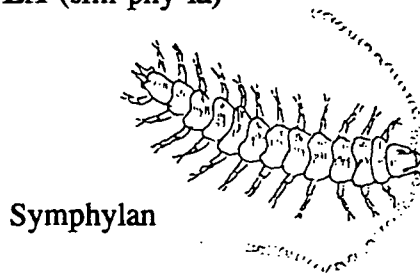
4. **DIPLOPODA** (dip'-low-poda) Millipedes, "thousand-legged worm"



Generally rounded, many segmented, long-bodied animals. One pair of short antennae. Two pair of legs to each body segment. When disturbed, they coil in a characteristic manner.

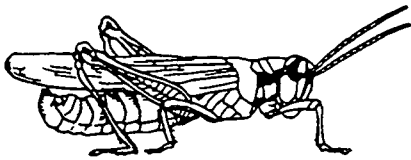


## 5. SYMPHYLA (sim-phy-la)

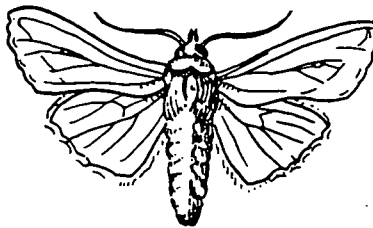


Twelve pairs of legs with two claws at tip of each leg. Two body regions. Head and body flattened. One pair long antennae. Inhabiting the soil.

## 6. HEXAPODA OR INSECTA



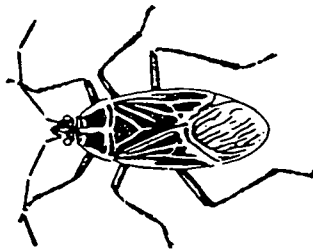
Grasshopper



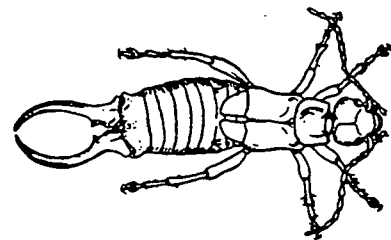
Armyworm



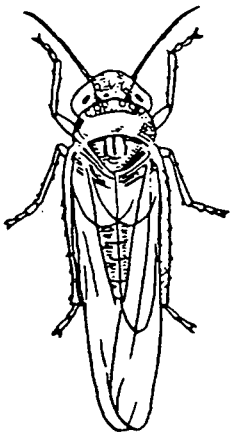
Blister beetle



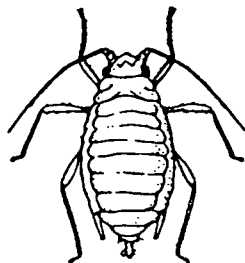
Boxelder Bug



Earwig



Leaf Hopper



Aphid



Mole Cricket



Swallowtail Butterfly

Body divided into three general regions (head, thorax and abdomen). Three pairs of legs. One pair of antennae. The only arthropods with wings.

**OBJECTIVES:** For youth to:

- identify the different classes of Arthropods
- correctly label each class
- distinguish between classes of Arthropods

**MATERIALS:**

- circle the insect sheet

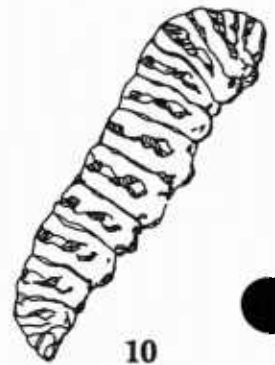
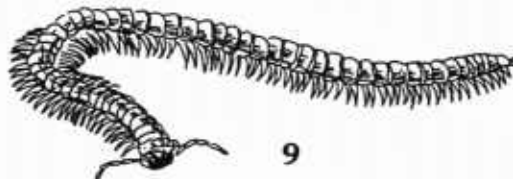
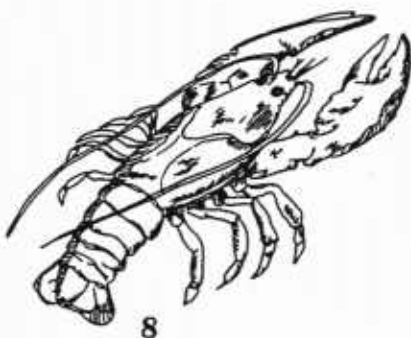
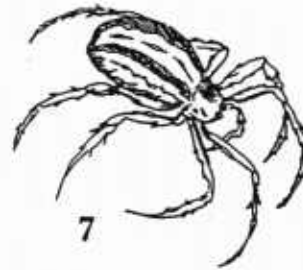
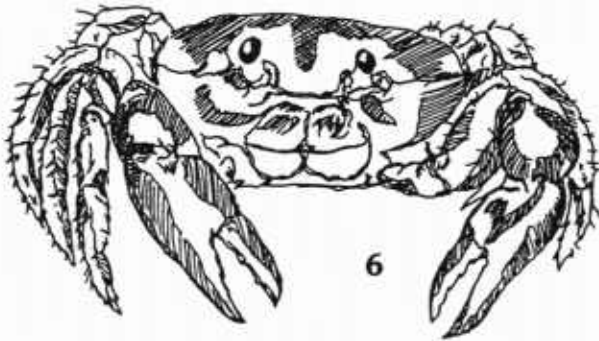
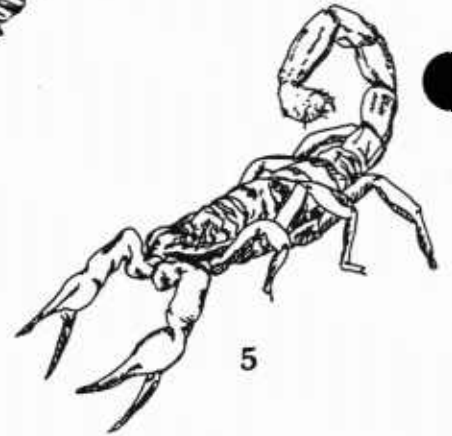
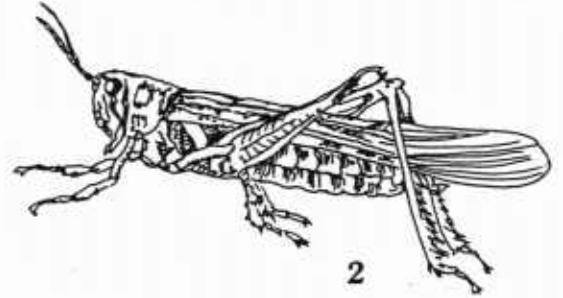
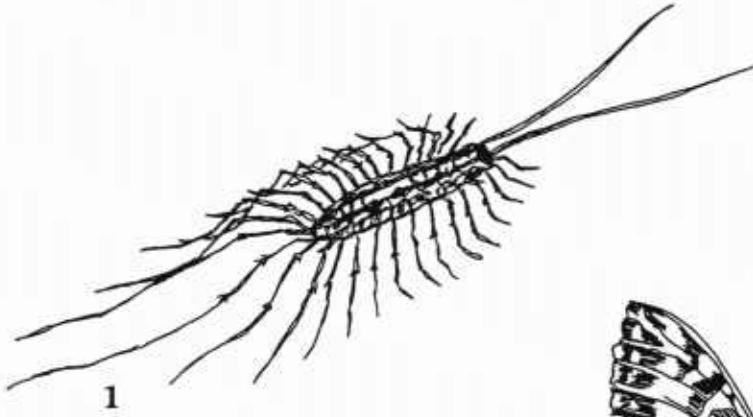
**TIME:** 5 to 15 minutes depending on the age of the group

**SUGGESTION:** review background basics with group

# CIRCLE THE INSECT



How many of these animals are insects? See how many you can find and circle.



**OBJECTIVES:** For youth to:

- compare body structures, life histories and habits of insects and spiders

**MATERIALS:**

- large pictures of spiders and insects
- cardboard or blank index cards
- paper bags
- names of insects and spiders on slips of paper

Insects and spiders are very closely related and people often confuse the two. But you can tell them apart by looking at several different characteristics and watching how the animals live. Listed below are some general differences between spiders and insects.

**INSECTS**

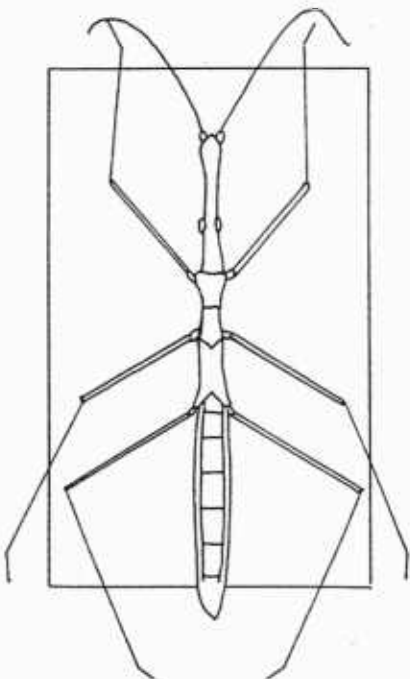
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- \* usually have 6 legs
- \* have 3 main body parts (head, thorax and abdomen)
- \* found in water and on land

**SPIDERS**

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- \* have 8 legs
- \* have 2 main body parts (cephalothorax, which is the head and thorax fused together, and abdomen.)
- \* usually live on land



## INSECTS

- \* have antennae
- \* eat a variety of things, from plants to animals to decayed material
- \* most don't spin silk, and those that do usually spin it from glands in their mouths
- \* usually have 2 compound eyes and several simple eyes
- \* usually have two pairs of wings



## SPIDERS

- \* have no antennae
- \* usually are carnivorous and paralyze their prey with poison
- \* most spin silk from spinnerets on their abdomens
- \* usually have 8 simple eyes and no compound eyes
- \* have no wings



"Reprinted with permission of National Wildlife Federation from the *Incredible Insects* issue of *NatureScope*, copyright 1989.

## PICTURE POSTCARDS

Cut out pictures of spiders and insects and hang them around the room. (You can also bring in live insects and spiders in glass jars so kids can watch these animals close up). Write the names of different kinds of insects and spiders on separate slips of paper so that there are enough for each person. (Make an equal number of spider and insect slips).

As a group, discuss the differences between spiders and insects. Point out the differences and similarities and make a list on the board or on a flip chart. Then divide the group into "spiders" and "insects" by having each person pick a slip of paper. Pair up a spider and an insect and pass out a piece of fairly stiff cardboard (4 1/4 x 5 1/2") or a large, blank index card to each person.

Tell them that each has to send a picture postcard to his or her partner. Here's how they'll do it:

- \* Go to the library in small groups to find out about their animals (what they look like, where they live, and what they eat.)
- \* Draw a picture of their insect or spider on one side of the postcard.
- \* On the other side, address the postcard to the habitat where the other person's animal might live. (for example, praying mantid--field; fishing spider--edge of pond)
- \* In the remaining space on the address side, write something about what their creature does and how it is the same as or different from their partners'. For example, here's what a praying mantid might write to a garden spider:



Dear Gerry Garden Spider,

Today I was crawling in the garden and saw a huge beetle. I grabbed it with my grasping front legs. It was probably something you would have liked too.

Sincerely,  
Paula Praying Mantid

By putting themselves in the place of a spider or insect, the kids will get a better feel for what each type of creature looks like and needs to stay alive. Afterward, have the kids exchange postcards. Then sit in a circle and have them read their partners' postcards aloud to the other kids. Have them look at the pictures of insects and spiders that are hanging around the room as the postcards are read. Here are some good insects and spider to use:

- \* **Insects:** grasshopper, termite, praying mantid, dragonfly, ant, wasp, bee, butterfly, moth, cockroach, cicada.
- \* **Spiders:** garden spider, jumping spider, house spider, black widow, tarantula, trapdoor spider, fishing spider, crab spider, wolf spider, lynx spider.

**OBJECTIVES:** To:

- provide more learning activities for club meetings

**MATERIALS:**

- listed per idea

**TIME:** depends on age of group and activity

**Activity Ideas To Distinguish Insects  
From Their Relatives**

1. After an introduction to the study of insects, ask them to name five different insects. If possible, write the names on a blackboard or large pad of paper so that everybody can see it. After the list is made (no more insects can be named by the club members), go over it and discuss any non-insects that may have been listed. Can the members group the list of insects into similar categories (butterflies, beetles, bugs, etc.)?
  
2. Ask the members to identify five characteristics that distinguish insects from their arthropod relatives like spiders, centipedes, millipedes and crustaceans? Record on the blackboard.

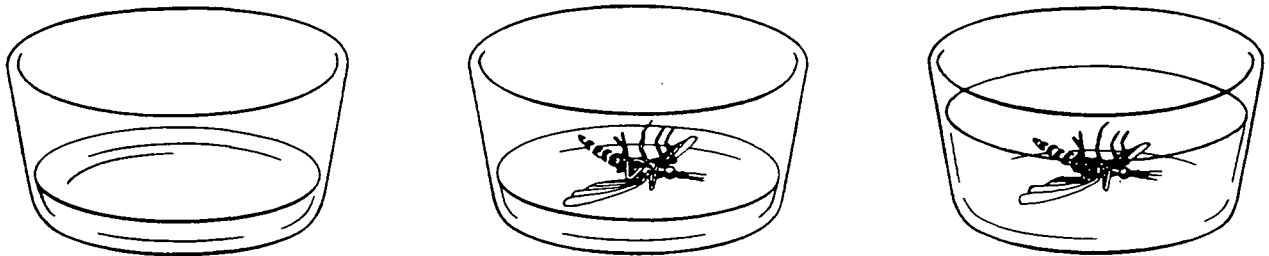
Have the members fill in a chart similar to the one given below so that they will have a better understanding of how insects differ from non-insect arthropods:

	Number of body parts	Number of legs	Antennae?
<b>Insects</b>	3	6	1 pair
<b>Spiders, Ticks &amp; Mites</b>	2	8	None
<b>Centipedes</b>	2	15-30 pairs	1 pair
<b>Millipedes</b>	2	> 30 pairs	1 pair
<b>Isopods</b>	2	7-11 pairs	2 pair

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"Reprinted with permission of Gary A. Dunn of Young Entomologists' Society, Inc., *Six-Legged Science: Insects in the Classroom*, October 1991.

3. Have the members play the "bug swap" game. You will need a small collection of insect and arthropod pictures (simple drawings or sketches will do). There should be at least two pictures for each arthropod class (insects, spiders, ticks, mites, scorpions, daddy-long-legs, centipedes, millipedes, crustaceans, and horseshoe crabs). You will need enough pictures so that each member has two pictures. Ask the members to sit on the floor in a circle. As you call out the name of an arthropod class, the members who have those pictures should change places with one another. Then call out another arthropod class. Play until each member has had at least one turn.
4. Try some poems, tongue twisters or riddles about insects. (Have the students make bug masks to wear as they read the poems, stories or riddles).
5. Help the students make their own insect fossil replicas. Place a dead insect into an inverted bottle cap. Drip clear nail polish onto the insect until it is completely covered. Let it dry. Repeat the process until 5 or 6 layers of polish have been applied. The insect now looks like it has been preserved in amber (petrified tree sap!)



6. Have the members calculate how many insects (try a variety of different species) it would take to make a pound; weigh a small sample of each insect and calculate the total number of insects it would take to make a pound (or other unit of measure).
7. Discuss what the world would be like without insects. What changes would take place if all insects suddenly died tomorrow? What would life be like for people and other animals?

Without insects it would be very different from the world we know today. Because insects pollinate many flowering plants, fewer plants would grow. Since many birds eat insects, fewer birds would exist. Fish, frogs, toads, skunks, and moles also would be less abundant because these living things feed upon insects.

Many insects that live in the soil help nature with its housecleaning. For example, ants living in a stump help nature rot or decay the stump. This allows new plants to grow in the same place.



Products such as honey, silk, and shellac would not exist if there were no insects. Many discoveries in genetics, medicine, and nutrition were made possible because insects were used in laboratory experiments. Truly, insects are a necessary part of nature.

Some insects are harmful. They annoy you, your pets, and farm animals. They destroy crops by eating the roots, seeds, leaves, and stems of plants. They get into your food, forcing you to discard it. They spread plant diseases such as Dutch elm disease and fireblight. In many parts of the world, insects also spread human diseases such as malaria, sleeping sickness, bubonic plague, and yellow fever.

#### CHART TO COMPARE INSECTS AND THEIR RELATIVES

	Number of body parts	Number of legs	Antennae?
<b>Insects</b>			
<b>Spiders, Ticks &amp; Mites</b>			
<b>Centipedes</b>			
<b>Millipedes</b>			
<b>Isopods</b>			

**PURPOSE**

To identify the different stages in the life cycles of insects. To learn the four processes of change (metamorphosis). To learn which ORDERS go through which kind of metamorphosis.

**OBJECTIVES**

Youth will be able to:

- ◆ define metamorphosis
- ◆ describe the four kinds of stages in metamorphosis
- ◆ identify which ORDER goes through metamorphic change

**LESSON TIME**

Lesson time depends on the activity which can range from a few minutes, one club meeting, to several days.

**LEARNING ACTIVITIES**

A Bucket of Mosquitoes  
Insect Match-Up  
Growing-Up Word Search  
Caterpillar Caper Maze  
Life Cycle Study  
Activity Ideas on How Insects Grow

**ADVANCED PREPARATION**

- ◆ Review How Insects Grow - Background Basics
- ◆ Review each activity and select appropriate ones for your age group
- ◆ Collect and prepare materials or allow youth to collect and prepare materials

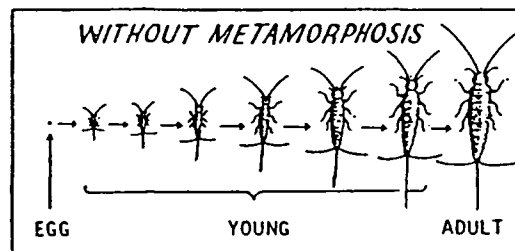
BACKGROUND BASICS

Insect growth is accompanied by a series of **MOLTS** necessary because the exoskeleton is incapable of expanding. The number of molts varies in different groups (**ORDERS**) from four to eight but there are exceptions.

Most insects hatch from eggs and go through several stages of life. Most insects change shape (form) as they grow and develop. This process of changing from egg to adult is called **METAMORPHOSIS** (met'-a-mor-pho-sis). Insects are divided into four groups, depending on their method of metamorphosis. Knowing the type of metamorphosis for each group (**ORDER**) of insects is very important for successful identification, rearing or pest control. It is generally true that during the insect life cycle it is the immature stage that consumes the most food.

**ORDERS**

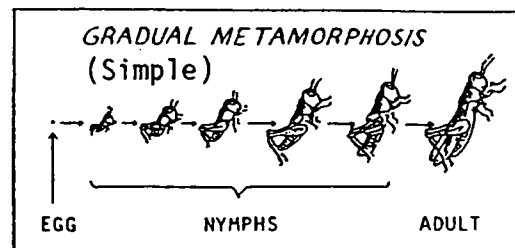
- THYSANURA (Silverfish)
- COLLEMBOLA (springtails)



In **GROUP 1** the insect that comes from the egg looks exactly like it will when grown, except it will then be larger.

**ORDERS**

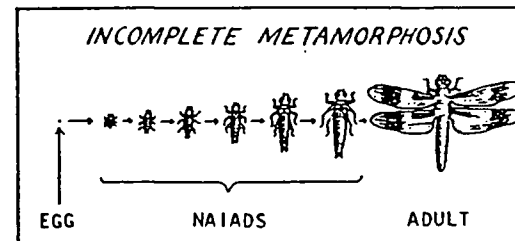
- ORTHOPTERA (Grasshopper)
- ISOPTERA (Termite)
- PSOCOPTERA (Book and bark lice)
- THYSANOPTERA (Thrips)
- HEMIPTERA (True bugs)
- HOMOPTERA (Aphids, leafhoppers, cicadas)
- DERMAPTERA (Earwigs)
- MALLOPHAGA (Biting lice)
- ANOPLURA (Sucking lice)



Insects in **GROUP 2** change shape gradually. There are three stages of growth: egg, nymph and adult. Nymphs are miniature copies of their parents, but without wings.

**ORDERS**

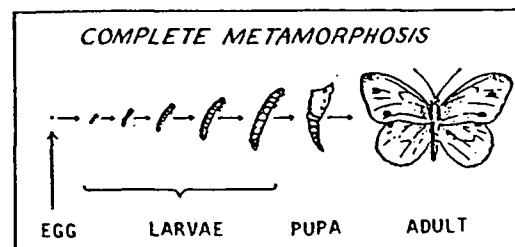
- E P H E M E R O P T E R A (Mayflies)
- ODONATA (Dragonflies)
- PLECOPTERA (Stoneflies)



The young insects in **GROUP 3** change size gradually. They do not look like adults until shedding their last skin. Then there is a dramatic change.

**ORDERS**

- NEUROPTERA (Lacewings)
- COLEOPTERA (Beetles)
- MECOPTERA (Scorpionflies)
- TRICHOPTERA (Caddisflies)
- LEPIDOPTERA (Moths, butterflies)
- DIPTERA (Flies)
- SIPHONAPTERA (Fleas)
- HYMENOPTERA (Bees, wasps)



All insects in **GROUP 4** go through four stages of growth. None of the young looks like the adult. There is a great change in shape when the adult emerges from the pupa stage.

**OBJECTIVES:** For youth to:

- observe and record mosquito metamorphosis
- recognize that some insects have aquatic stages in their development
- to raise mosquitoes and get a close-up look at their egg, larvae, pupae, adult stages

**MATERIALS:**

- bucket or dishpan
- piece of burlap
- pond water
- strainer
- magnifying glass
- fertilizer or plant food
- window screening to cover the bucket

**TIME:** 2 to 3 weeks to complete the full cycle

**SUGGESTIONS:**

The short method of finding eggs, wrigglers or tumblers is less time-consuming. Take the club members on a hiking adventure to find these life stages in standing water sources.

**How to Do It (The Long Way):**

Line a bucket or dishpan with burlap and fill it halfway with tap water. Let it stand outside for a day so that any chlorine in the water will disappear. Then add some filtered pond water. (Pour it through a strainer to keep out all the larger mosquito predators.)

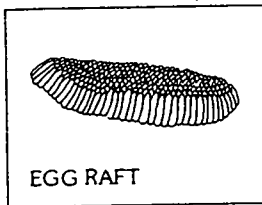
Add a pinch of fertilizer or plant food to help speed the growth of algae in the water. The algae will provide food for the mosquito larvae. You can also sprinkle a pinch of ground-dog biscuits on the surface of the water for larvae food.

Now wait and watch and hope that an adult female mosquito comes by and lays eggs on the water. One of the most common mosquitoes (*Culex*) lays its eggs in floating *rafts*, or clumps, on the surface. Other kinds of mosquitoes lay them singly or at the water's edge. Once you see the eggs, cover the container with a piece of window screening.



Each day have your members examine the bucket with a magnifying glass and record everything they see. In one to five days the eggs should hatch into wrigglers. The wrigglers will swim around for one to two weeks and then change into tumblers. Mosquito tumblers are unlike many other insect pupae because they move around. In a few days, the adults will emerge.

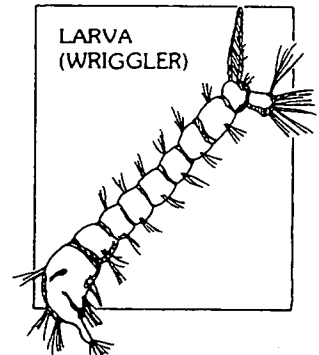
## How to do it the short way:



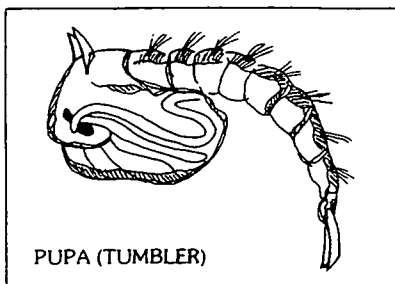
If, despite your efforts, your container fails to attract mosquitoes, try finding some eggs, wrigglers, or tumblers that you can transfer to your bucket or dishpan. Almost any source of standing water is a good place to search: ponds, stagnant pools; even old tires with standing water inside make good mosquito breeding grounds.

Here are some things to have your kids look for as your mosquito "family" develops:

- \* How the larvae breathe (They hang upside down from the surface and breathe through a breathing tube on their abdomen.)
- \* How the pupae breathe (They breathe at the surface with a pair of breathing tubes on their thorax.)
- \* How the adults crawl out of the pupal cases.
- \* What time of day the mosquitoes are most active.
- \* How many eggs are in a raft.
- \* The size and shape of the antennae (on the males they are very bushy; the females have shorter, less feathery ones)
- \* What other creatures are in the water



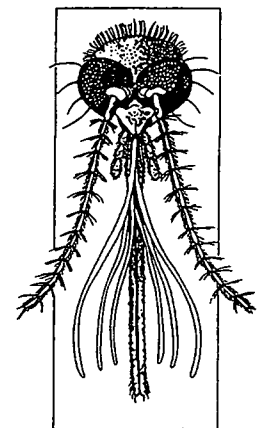
After observing for a few days, add some unfiltered pond water to the bucket. Try to get as many pond predators as possible (dragonfly and damselfly nymphs, small fish, etc.) Also add some pond plants and bottom mud. Have the kids watch to see what eats the mosquito eggs, larvae, and pupae.



Talk about mosquito pest problems. (Many spread diseases to people and other animals, and they are difficult to control because they reproduce so quickly and are resistant to many types of chemical controls.) Then discuss how predators are now used to help control mosquitoes. (Dragonflies and fish are introduced into mosquito-infested areas).

When your experiment is done, pour the water back into the pond and clean up the equipment. If you leave standing water outside, you will breed mosquitoes all season.

As a follow-up, go on a mosquito patrol in your neighborhood. Look for mosquito breeding areas. How have people created mosquito breeding habitats (piles of old tires with standing water inside, polluted streams of stagnant water)? Plan a clean-up of your neighborhood to get rid of as many potential mosquito breeding sites as you can.



**OBJECTIVES:** For youth to:

- match adult insects to their larvae forms
- recognize the adult and larvae stages of a particular insect

**MATERIALS:**

- Insect Match-Up Sheet

**TIME:** 15 to 20 minutes depending on age of group

**BACKGROUND INFORMATION**

Mosquitoes and flies are both in the order Diptera. Their young are called maggots which have no legs and appear to have no head. The butterfly is in the Lepidoptera order in which their young are called caterpillars and can have either three pair of back legs or five pair of back legs.

Beetle larvae, in the order Coleoptera, are called grubs and can have legs or not, but usually have a distinguishing head - unlike the fly maggots. Dragonflies, in the order Odonata, have young that live in the water and have all distinctive body parts.

# INSECT MATCH-UP

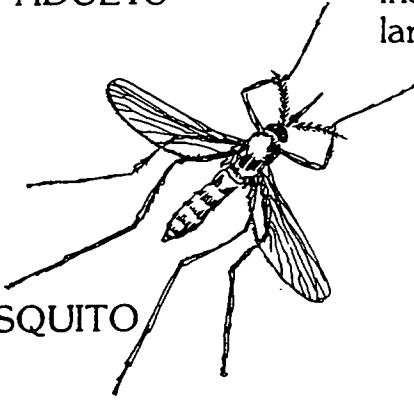


## ADULTS

Draw a line to connect each insect adult with the picture of its larva or nymph.

## NYMPHS & LARVAE

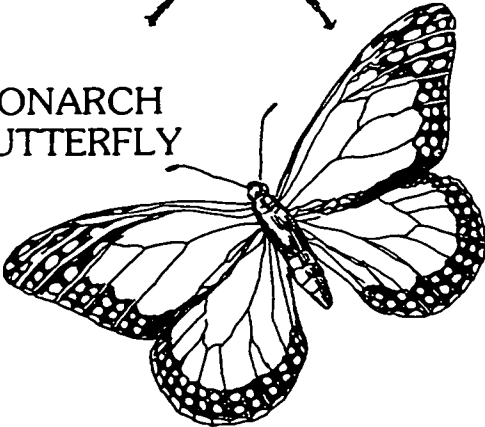
MOSQUITO



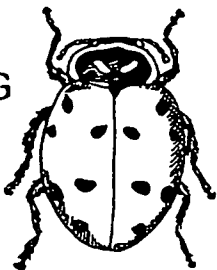
HOUSE FLY



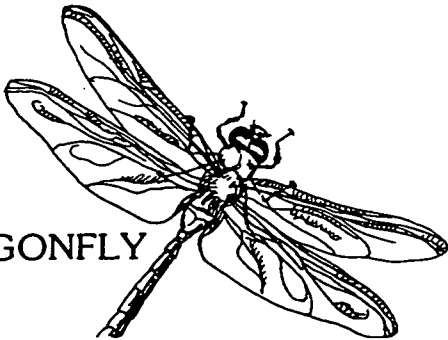
MONARCH BUTTERFLY



LADYBUG BEETLE



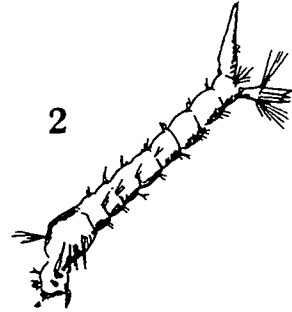
DRAGONFLY



1



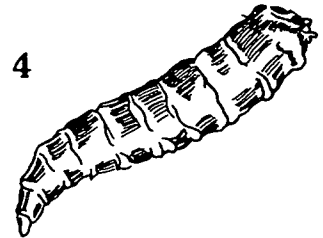
2



3



4



5



**OBJECTIVES:** For youth to:

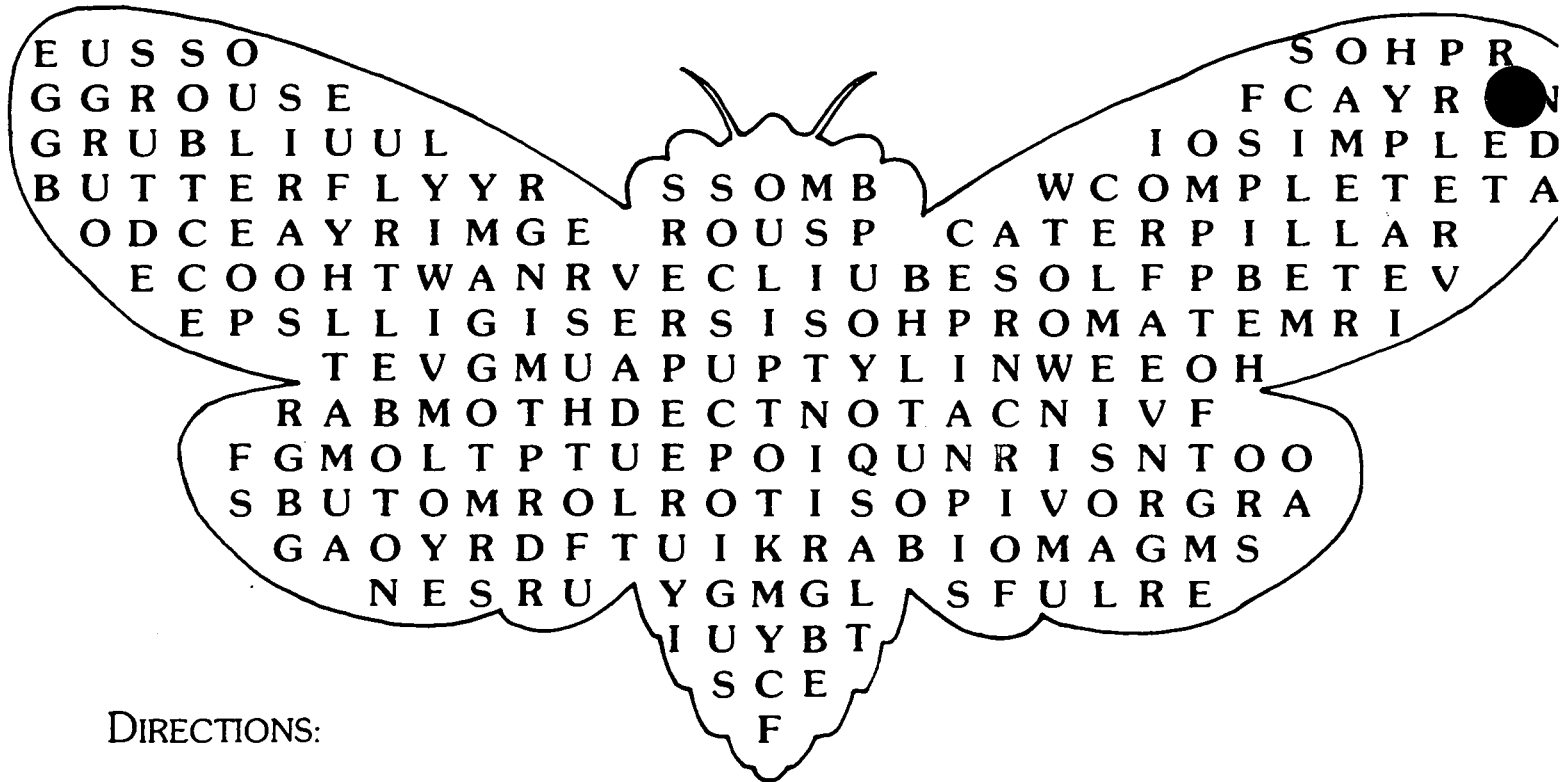
- Learn the vocabulary of the growth stages in insects
- have fun finding the hidden words

**MATERIALS:**

- Growing-Up Word Search Sheet

**TIME:** 15 minutes to whole club meeting depending on age of group





### DIRECTIONS:

Use the clues below to find the insect words hidden in the cicada. The words may read frontward, backward, up, down, and diagonally.

1. The larva of this insect often spins a cocoon: \_\_\_\_\_
2. An insect goes through many changes to become an \_\_\_\_\_.
3. Nymphs and larvae can't fly because they don't have fully developed \_\_\_\_\_.
4. The larva of this insect makes a chrysalis: \_\_\_\_\_.
5. The changes an insect goes through as it grows are called \_\_\_\_\_.
6. The nymphs of many aquatic insects breathe with \_\_\_\_\_.
7. The first stage in an insect's life cycle is the \_\_\_\_\_.
8. An insect that changes in 4 life stages—egg, larva, pupa, adult—goes through \_\_\_\_\_ metamorphosis.
9. In complete metamorphosis, the egg hatches into the \_\_\_\_\_.
10. An insect that changes in 3 life stages—egg, nymph, adult—goes through \_\_\_\_\_, or incomplete, metamorphosis.
11. To grow, an insect must \_\_\_\_\_, or shed its exoskeleton.
12. A \_\_\_\_\_ is the young form of an insect that goes through incomplete or simple metamorphosis.
13. Female insects deposit their eggs through an \_\_\_\_\_.
14. A moth or butterfly larva is called a \_\_\_\_\_.
15. The \_\_\_\_\_ is the resting stage of complete metamorphosis.
16. The larva of a beetle is sometimes called a \_\_\_\_\_.
17. The larva of a fly is sometimes called a \_\_\_\_\_.

**OBJECTIVES:** For youth to:

- recognize two life stages of the monarch butterfly
- solve a problem of connecting two points
- determine the identity of the adult stage and draw it.

**MATERIALS:**

- Caterpillar Caper Maze Sheet

**TIME:** Depends on age of group

**SUGGESTION:** Have picture of adult monarch butterfly available for reference. If milkweed plants are available in your area, watch for larvae, chrysalis or adults on the plants.

**BACKGROUND INFORMATION**

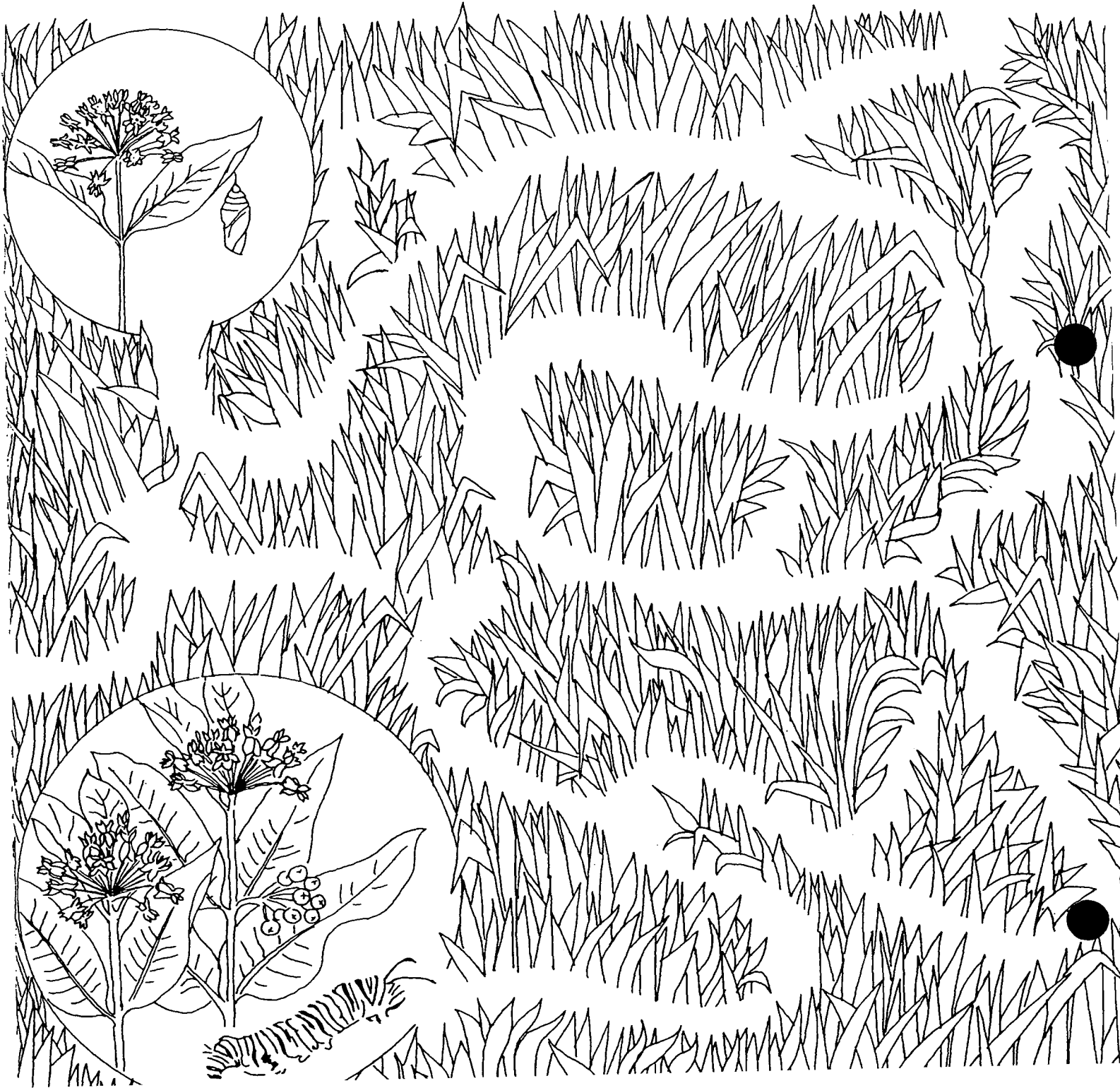
The milkweed plant is a favorite of the monarch butterfly. The larvae feed on the plant, ingesting the milky substance. The chemicals in the milk (toxic resins) become incorporated into the larvae's body. As an adult, the monarch butterfly retains these resins which causes it to be distasteful to predators, such as birds. This is one way the monarch butterfly can protect itself from predators.

# COPYCAT PAGE

# CATERPILLAR CAPER MAZE

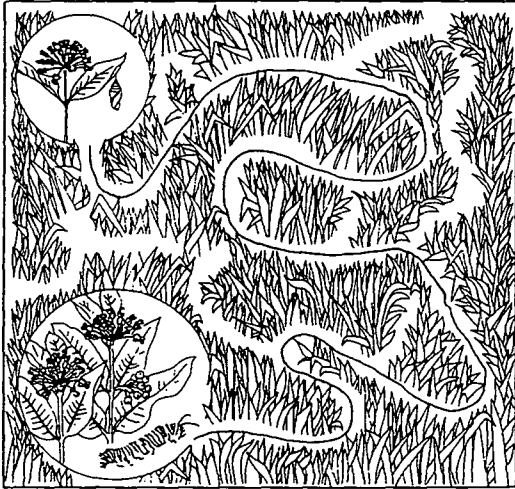


Help this monarch caterpillar find its way to another clump of milkweed. Then draw a picture of what you think will someday crawl out of the chrysalis that is hanging from the milkweed plant.



# ANSWERS TO COPYCAT PAGES

Caterpillar Caper Maze (p. 23)



Amazing Insect Mouths (p. 34)

1. butterfly 2. grasshopper 3. mosquito

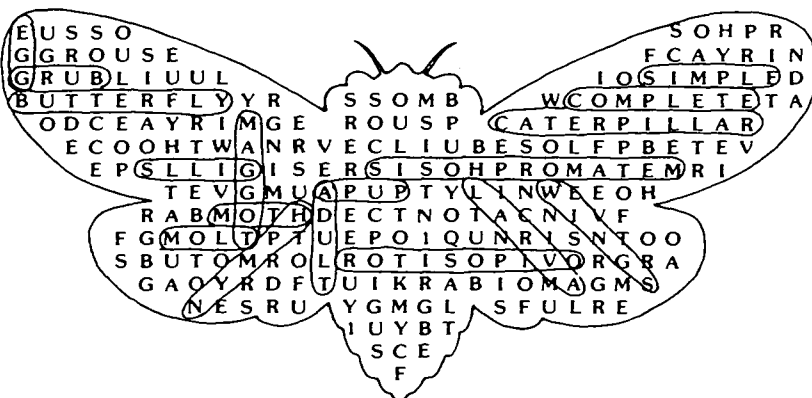
Circle the Insect (p. 14)

- Insects: 2. grasshopper 3. butterfly 10. caterpillar (swallowtail)  
 Non-insects: 1. centipede 4. tick 5. scorpion  
 6. crab 7. spider 8. crayfish 9. millipede

Insect Match-Up (p. 24)

- mosquito—2, house fly—4, monarch butterfly—1, ladybug beetle—5, dragonfly—3

Growing-Up Word Search (p. 25)



1. moth 2. adult 3. wings 4. butterfly 5. metamorphosis 6. gills 7. egg 8. complete 9. larva 10. simple 11. molt 12. nymph 13. ovipositor 14. caterpillar 15. pupa 16. grub 17. maggot

**OBJECTIVES:** For youth to:

- observe the different stages of growth of an insect
- observe what an insect eats, what its habits are and how it reproduces

**MATERIALS:**

- glass container or flower pot with bottom
- gauze or wire screen
- plastic cylinder
- string, rubber band or wire

**TIME:** One club meeting to assemble rearing cages. A hike to collect specimens. Several weeks of observation until life cycle is completed—depends on the stage collected and species of insect.

**BACKGROUND INFORMATION**

Life cycle studies are conducted to observe how an insect lives, what it eats, what its habits are, and how it reproduces. As part of the study a specimen is kept in a rearing cage so that the different stages of growth observed will be of the same insect.

An insect must be kept in as natural a condition as possible. It needs certain things to complete its life cycle, these include:

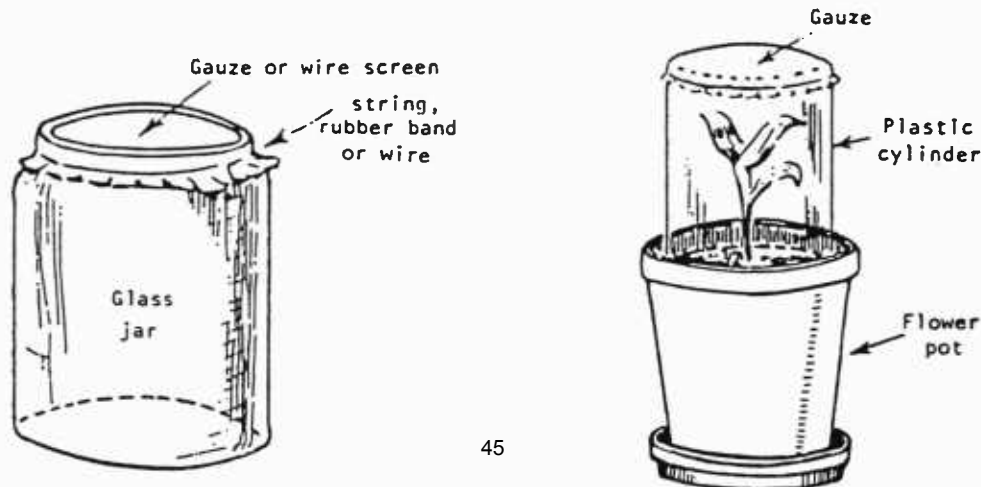
water	heat
air	other insects of its kind
soil	food

These requirements change as the insect passes from one stage of growth to another.

**REARING CAGE**

Most insects are easy to rear if you provide them with an environment similar to that in which they were found. For example, if you wish to rear a caterpillar found on oak leaves, place it in the cage with oak leaves to eat. Unless you are familiar with the habits of the insect being reared, it is best to provide a few inches of soil in the bottom of the rearing cage, as many insects must have soil in which to pupate or transform from the larvae to the adult stage.

Below are two simple types of rearing cages for most insects.



## **EASY INSECTS TO REAR**

Most **butterflies or moths** can be reared by collecting eggs or young caterpillars and providing fresh food from the plants where they were found. Place them in large pickle jars or cages made of screen wire rolled into a cylinder. Close the ends with cardboard. Place an inch or two of soil in the bottom of the cage as many caterpillars pupate in the soil. Place a branch in the jar for the adult to climb on when it emerges.

**Houseflies** can be reared in glass jars with a small dish filled with damp bran and with sugar in the bottom of the jar. Keep the bran moist, but not soaking wet.

**Aphids** are easy to rear on the host plant which should be potted and covered with a glass jar or placed in a glass jar.

Rear **lady beetles** from eggs or small larvae, caged with a colony of aphids on a host plant. Lady beetles consume large numbers of aphids, so be sure the food supply is plentiful.

## **PROCEDURES**

1. Select a rearing cage appropriate for the insect.
2. Collect eggs, larvae, or adults of the insect and place them in the rearing cage with appropriate food.
3. Suggested things to observe and record about the insect:
  - a. common name
  - b. stage of insect with which you started (egg, larvae, pupa, adult?)
  - c. food used
  - d. type of mouth parts (see lesson 1)
  - e. date eggs laid
  - g. date eggs hatched
  - h. date insect pupated
  - i. date insect reached adult stage
  - j. number of days adult lived
4. Prepare in your display case the various stages of the insect from egg to adult. (see Lesson 8 - Materials Needed For Collecting Insects.)
5. Ask the members to give a presentation to the club on their project.
6. Have the members prepare Educational Displays on their project.

**OBJECTIVES: To:**

- o do more learning activities regarding metamorphosis

**MATERIALS:**

- o listed per ideas

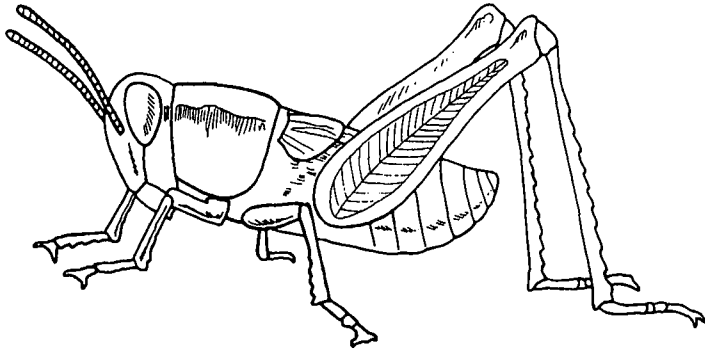
**TIME:** depends on activity.

## Activity Ideas on How Insects Grow

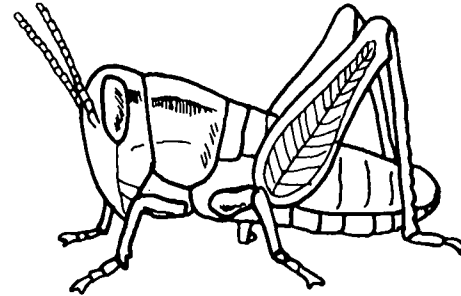
1. Discuss how insects vary in their growth patterns as compared to other animals. Because they are enclosed within a non-living "shell" they must shed this skeleton in order to grow. Their bodies also change shape as they grow, a process known as metamorphosis. Review the four types of metamorphosis and associate each one with the correct immature stage. They are:

<u>Type of metamorphosis</u>	<u>Name of Immature</u>	<u>Common Names</u>
No metamorphosis	young	none
Gradual metamorphosis	nymph	none
Incomplete metamorphosis	naiad	none
Complete metamorphosis	larva	maggot/grub/caterpillar

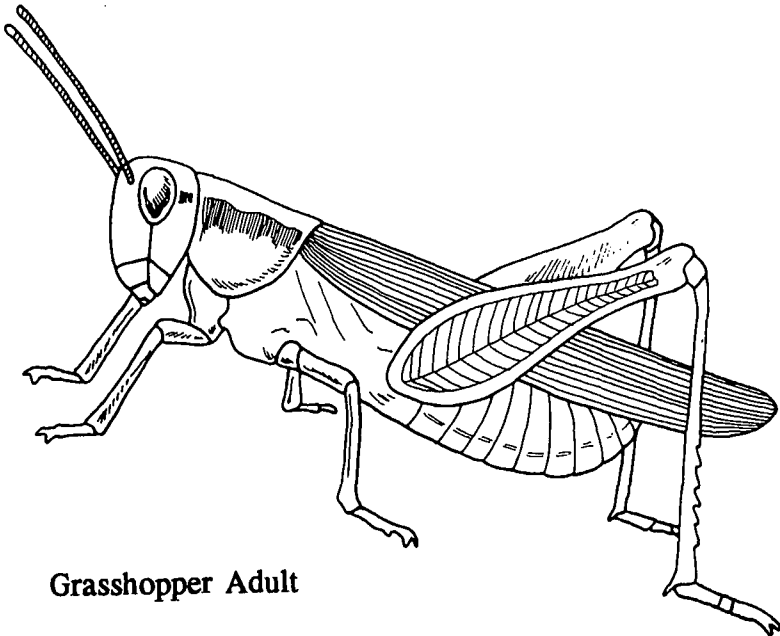
2. Have members (either in small groups or individually) design a poster which shows either the incomplete or complete metamorphosis of an insect using drawings, photographs or actual specimens from the cultures.
3. Have the youth relax and close their eyes while you read a story about metamorphosis. Ask the members to imagine that they are the insect character undergoing the activities and changes in the story. Have them describe what they think it would be like to change shape as you grow up.
4. Make an insect life cycle mobile. Draw, color, cut and assemble into separate mobiles representative of each life stage of gradual metamorphosis (egg-nymph-adult) and complete metamorphosis (egg-larva-pupa-adult). Hang the mobiles in a prominent place.



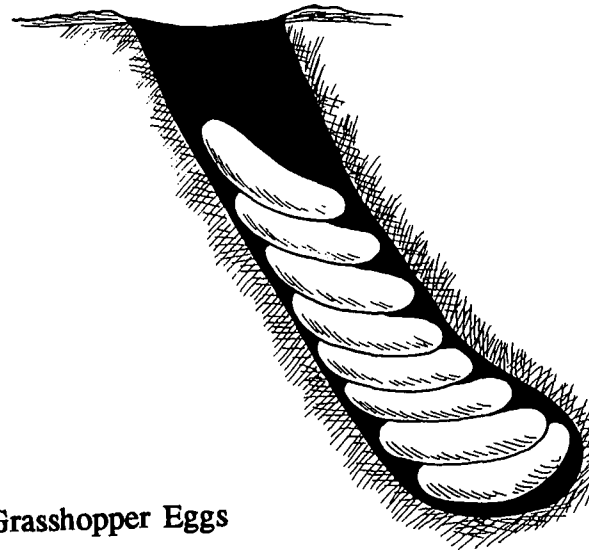
Grasshopper Nymph (Older)



Grasshopper Nymph (Young)

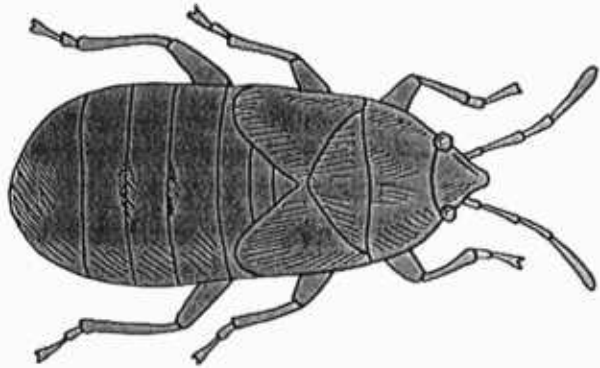


Grasshopper Adult



Grasshopper Eggs

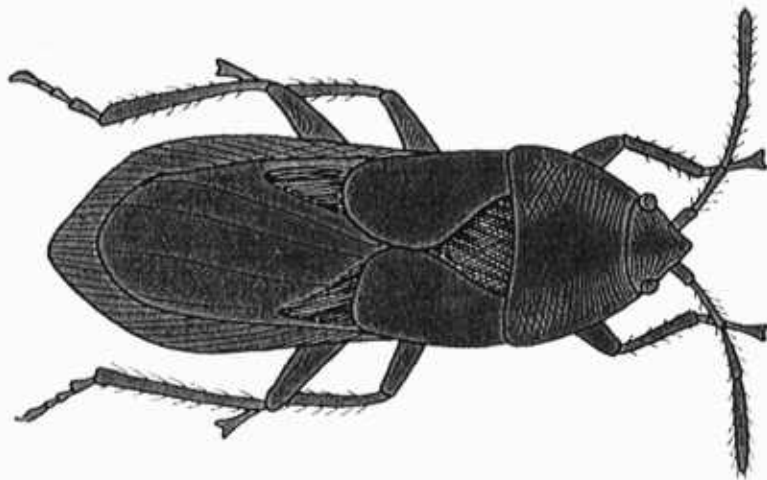




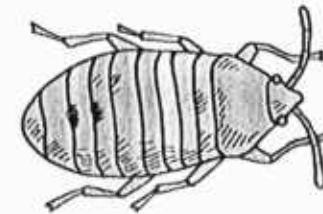
True Bug Older Nymph



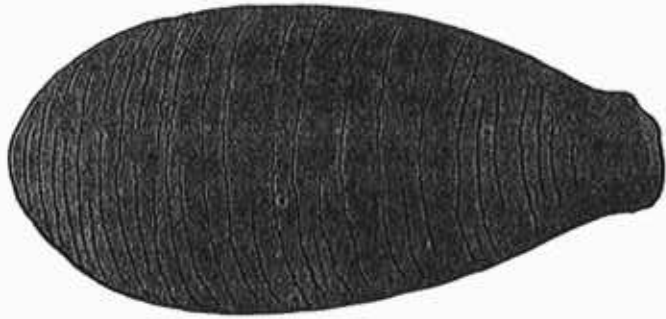
True Bug Egg



True Bug Adult



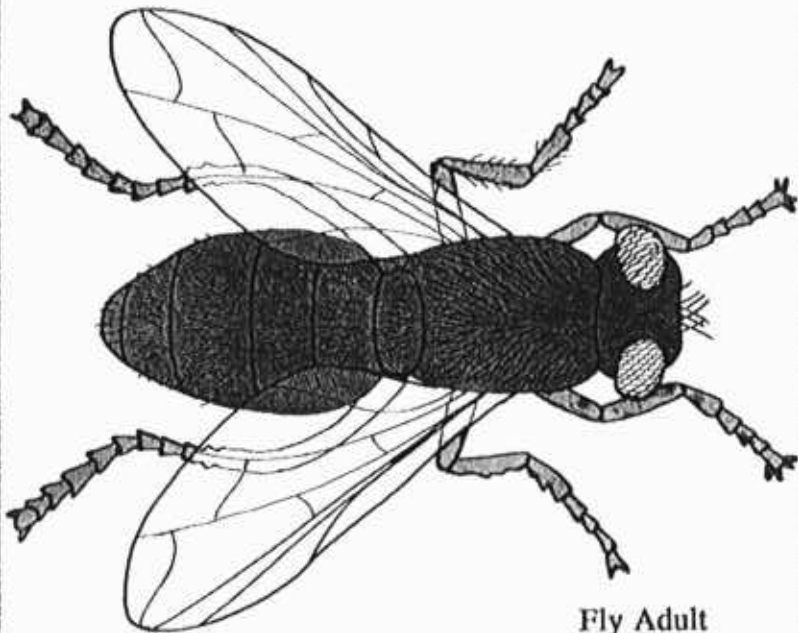
True Bug Young Nymph



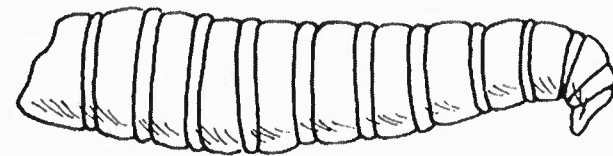
Fly Pupa



Fly Egg



Fly Adult



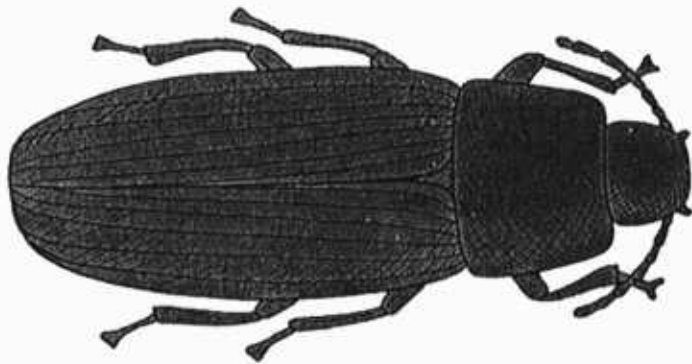
Fly Maggot



Beetle Pupa



Beetle Egg



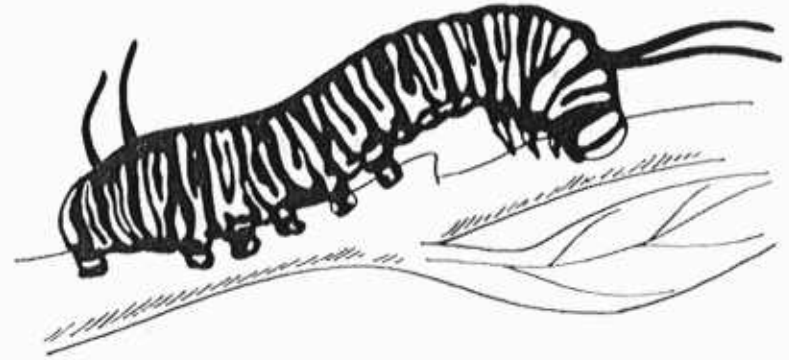
Beetle Adult



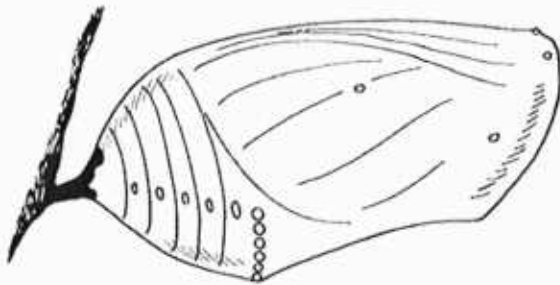
Beetle Larva



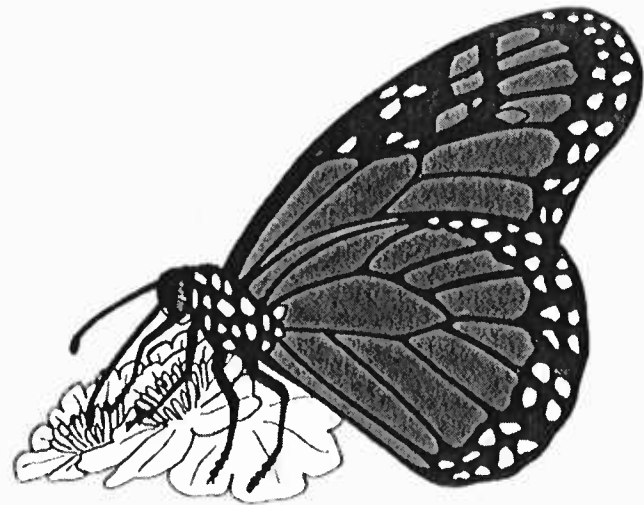
Butterfly Egg



Butterfly Larva



Butterfly Pupa



Butterfly Adult

**PURPOSE**

To learn how the classification system works. To distinguish between the different orders of insects.

**OBJECTIVES**

Youth will be able to:

- ◆ learn the system of nomenclature
- ◆ identify the seven major orders of insects
- ◆ learn scientific and common names of orders
- ◆ learn general physical characteristics of orders
- ◆ learn how to use a "key"
- ◆ learn decision-making skills

**LESSON TIME**

Learning classification will be an on-going process throughout the 4-H'ers entomology project years.

**LEARNING ACTIVITIES**

Activity Ideas on Learning to Classify

**ADVANCED PREPARATION**

- ◆ Review How Insects Are Classified - Background Basics
- ◆ Review Ideas for learning classification
- ◆ Collect and prepare materials or have 4-H members collect and prepare materials.

## LESSON 4: HOW INSECTS ARE CLASSIFIED

### ACTIVITY 1: How Insects Are Classified

**OBJECTIVES:** To:

- do more learning activities regarding classification

**MATERIALS:**

- listed per ideas

**TIME:** depends on activity

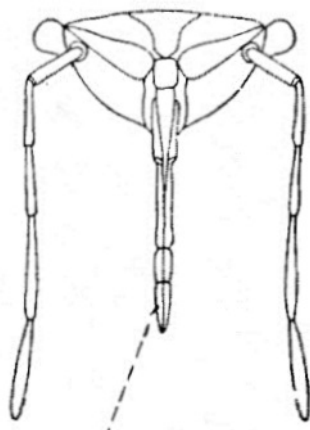
### ACTIVITY IDEAS FOR LEARNING CLASSIFICATIONS

- Have members give examples of insect orders and some of the insects in each order. You might try the "insect alphabet", naming an insect beginning with the letter "A" (antlion), "B" (butterfly), etc. Have the students place the insects in the proper group (order).
- Make a poster, bulletin board or "insect art gallery" of insect pictures highlighting insect shapes, sizes and colors. Have the students draw their own pictures, or collect pictures from magazines, pesticide sales literature, extension publications or other sources.
- Make an arthropod (or insect) family tree poster - each branch should represent a different order. Leave enough room on each branch to place pictures of representative "family" members. Try to arrange the branches so the most closely related members are near each other (i.e., spiders, ticks, mites and scorpions vs. insects, millipedes and centipedes). If you have room you can also use a real tree branch (set in plaster or pebble-filled bucket) in which to hang your pictures.
- Write several questions on insect order classification on slips of paper. Have each member draw a slip of paper and then answer the question. Questions could include the following:
  - Which order has the largest number of insects? (Beetles)
  - How does the Hemiptera differ from the Homoptera? (Type of wings)
  - Are the butterfly, caddisfly and horse fly in the same order? Why or why not? (No: butterfly - Lepidoptera, caddisfly - Trichoptera, horse fly - Diptera)
  - Are the lightningbug, ladybug and bed bug in the same order? Why or why not? (No: lightningbug and ladybug - Coleoptera, bed bug - Hemiptera)
  - Name an insect order with gradual metamorphosis. (Orthoptera, Dermaptera, Isoptera, Mallophaga, Anoplura, Hemiptera or Homoptera)For variation, have the members roll a die. If a youth rolls a 2, he/she would answer the second question (and so on). This will challenge all the members to think of the answer to each question, since they don't know which number they will roll. Display all the questions on a chalkboard or piece of poster paper in front of the group.

- e. Provide each 4-Her with at least one picture of an insect. Instruct the youth not to show their picture to the others. Have the other members ask "20 questions" to discover the identity of the insect. For example, "Does your insect have wings?" (Student answers "yes" or "no", depending on the insect he/she has.) Continue until somebody guesses the correct identity of the "mystery" insect.
- f. In a round robin session with members begin naming some of the insect orders using their scientific names. Have the 4-Hers reply with the common name (or vice versa) for the order (or at least give an example of an insect from that order).
- g. Conduct an investigation into the meanings of insect scientific names (orders and families). For example. Coleoptera - coleo=sheath and ptera=wing describes the sheath-like or armor-like wings of the beetles. (see appendix)
- h. Practice using a key with insects of known orders. This will teach the members physical anatomy vocabulary and help them with decision making skills, while ensuring a positive learning experience. Then practice using the key with insects of which their order is unknown.
- i. Make use of games, i.e. insect, tac, toe or insect jeopardy.

## Oregon 4-H Key to the Orders of Insects

This is a dichotomous key to insect orders and a few suborders. The root word “dicot” means two. There are two choices of insect characteristics at each step in the key. The first choice in each step is indicated by the number of the step alone, for example 1. The second choice in the step is indicated by the number and the symbol=' , for example 1' . Beyond Step 1 each step also indicates which step came before that step. For example 2 (1) indicates step 1 came before step 2. This is particularly useful when the key sends the user many steps forward, for example 24(1'). It is also useful in backtracking the characteristics of an insect. Use the Glossary in the back of *Getting to Know the Insects*, by Erin Hodgson, to assist with the words used in this key. Additional opportunities to learn the names of insect parts and how to identify orders are provided by the Unit 1, Unit 2, and Unit 3 interactive tutorials and printed materials on the Oregon State 4-H Entomology project web site.



Sucking mouthparts

Figure 1



Chewing mouthparts

Figure 2

Step	Characteristics	Go on to this step	Order, Suborder
1	Wings well developed	2	
1'	Wingless, or with small, undeveloped wings	24	
2 (1)	Front wings (elytra) hardened, leathery, at least at base; hind wings, if present, membranous	3	
2'	Wings membranous, not hardened or leathery	9	
3 (2)	Sucking mouth parts, with beak longer than wide, and usually segmented (Figure 1) <b>Hemiptera</b>	4	
3'	Chewing mouth parts (Figure 2)	5	



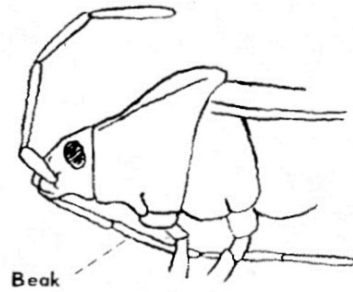


Figure 3

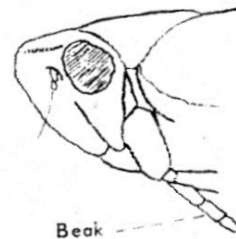


Figure 4

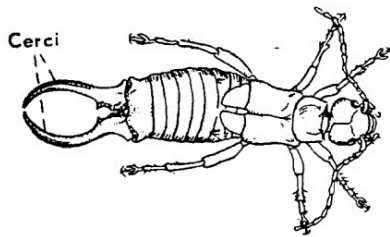


Figure 5

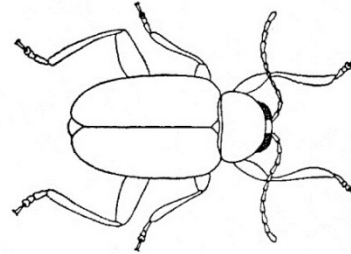


Figure 6

Step	Characteristics	Go on to this step	Order, Suborder
4(3)	Beak arising from front part of head (Figure 3); front wings usually leathery at base and membranous (skinlike) at tip; tips generally overlapping when at rest (true bugs)		<b>Hemiptera</b> , suborder Heteroptera
4'	Beak arising from rear underside part of head, often appearing to rise at base of front legs (Figure 4); front wings of uniform texture throughout; tips not overlapping or only slightly overlapping when at rest (leafhoppers, cicadas, aphids, treehoppers)		<b>Hemiptera</b> , suborders Auchenorrhyncha & Sternorrhyncha
5(3')	Abdomen with forcepslike cerci (Figure 5); front wings (elytra) short, leaving most of the abdomen exposed, tarsi 3-segmented (earwigs)		<b>Dermaptera</b>
5'	Abdomen without forcepslike cerci, or if cerci appear forcepslike, then wings cover most of abdomen, tarsi variable	<b>6</b>	
6(5')	Front wings without veins, usually meeting in a straight line down middle of back (Figure 6); antennae with 11 or fewer segments; hind wings narrow, usually longer than front wings when unfolded, and with few veins (beetles)		<b>Coleoptera</b>
6'	Front wings with veins, either held rooflike over abdomen or overlapping over abdomen when at rest (Figure 7); antennae generally with more than 12 segments; hind wings broad, usually shorter than front wings, and with many veins, usually folded fan-wise at rest (Figure 8)	<b>7</b>	

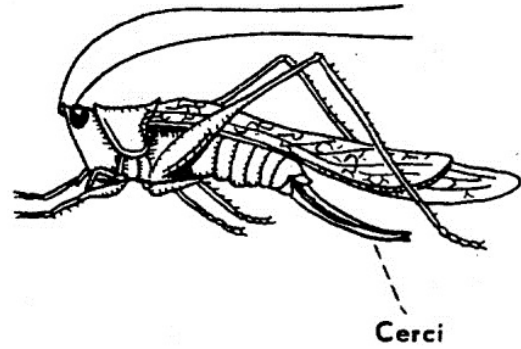
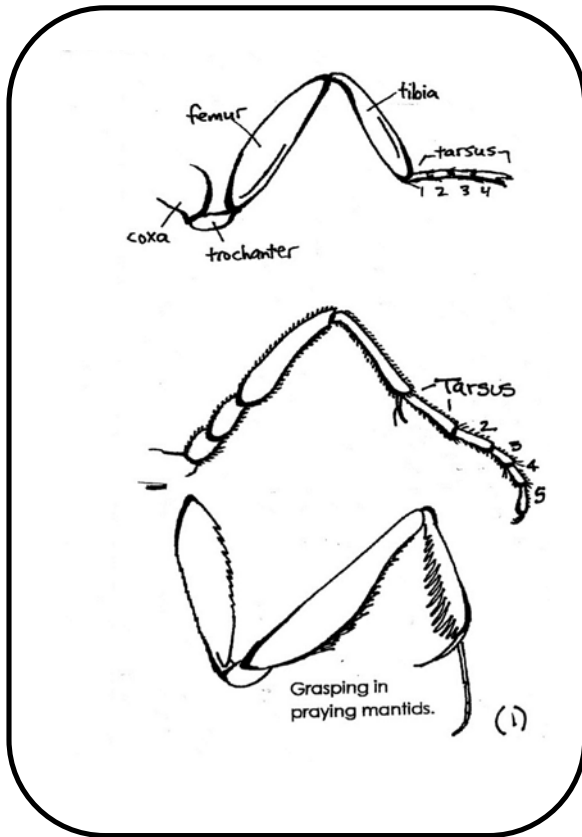


Figure 7

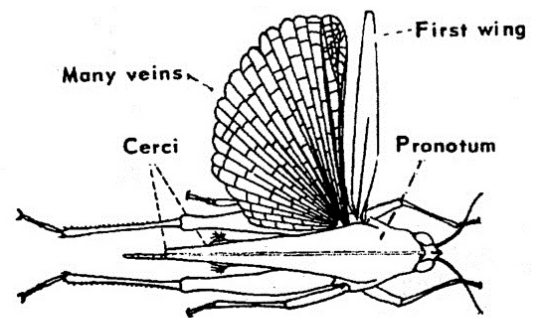


Figure 8

Step	Characteristics	Go on to this step	Order, Suborder
7(6')	Tarsi with 4 or fewer segments (see tarsi illustration above); usually jumping insects, with hind femora more or less enlarged (Figure 7) (grasshoppers, crickets)		<b>Orthoptera</b>
7'	Tarsi 5 segmented (see tarsi illustration above); running or walking insects, with hind femora not particularly enlarged	<b>8</b>	
8 (7')	Prothorax much longer than mesothorax; front legs modified for grasping prey (see illustration above); (mantids)		<b>Mantodea</b>
8'	Prothorax not greatly lengthened; front legs not modified for grasping prey (cockroaches)		<b>Blattodea</b>
9(2')	With two wings	<b>10</b>	
9'	With four wings	<b>13</b>	
10(9)	Body grasshopper-like; pronotum extending back over abdomen, pointed at tip (Figure 8); hind legs enlarged (pygmy grasshoppers, family Tetrigidae)		<b>Orthoptera</b>
10'	Body not grasshopper-like; pronotum not as above; hind legs not so enlarged	<b>11</b>	

(1) *Getting to Know the Insects*, Erin Hodgson, Extension Entomologist, Department of Entomology, Iowa State University

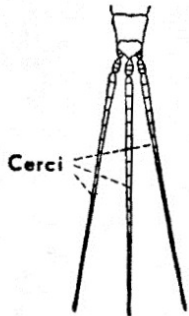


Figure 9

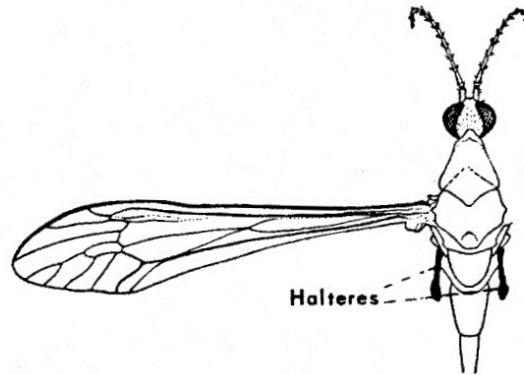


Figure 10

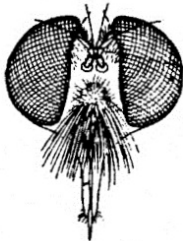


Figure 11

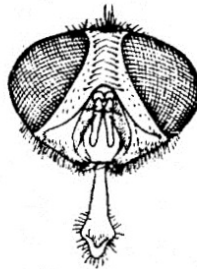


Figure 12



Figure 13

Step	Characteristics	Go on to this step	Order, Suborder
11(10')	Abdomen with threadlike or spinelike cerci (Figure 9); mouth parts small or undeveloped; halteres (Figure 10) may be present or absent	12	
11'	Abdomen without threadlike or spinelike cerci; mouth parts usually well developed, forming sucking beak (Figure 11) or tongue (Figure 12); halteres present (true flies, mosquitoes, gnats, midges)		<b>Diptera</b>
12(11)	Halteres (Figure 10) present and hooklike; wings with only one forked vein (Figure 13); antenna long and conspicuous; very small insects, usually less than 3/8-inch long (male scale insects, family coccidae)		<b>Hemiptera,</b> suborder Sternorrhyncha
12'	Halteres absent; wings with many veins and cross-veins; antennae short, bristlelike, small; usually over 1/8-inch long (mayflies)		<b>Ephemeroptera</b>

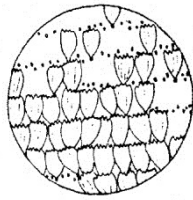
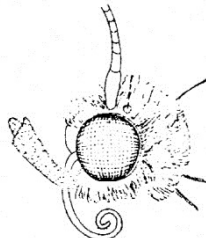


Figure 14



Coiled mouthparts

Figure 15

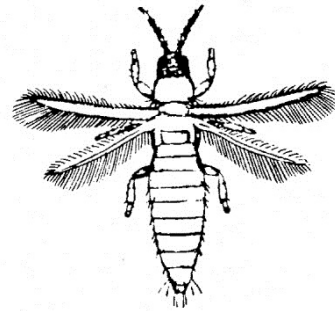


Figure 16

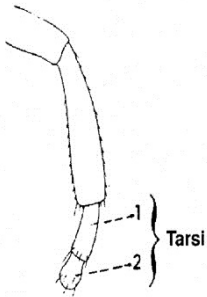


Figure 17

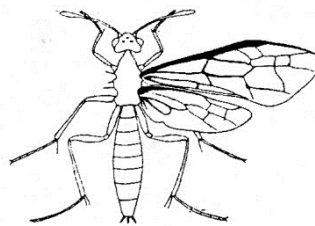


Figure 18

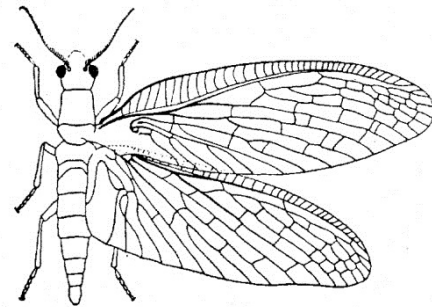


Figure 19

Step	Characteristics	Go on to this step	Order, Suborder
13(9')	Wings completely or almost completely covered with microscopic, powderlike scales (Figure 14); mouth parts usually in the form of a long, coiled, tubelike beak or tongue (Figure 15); antennae many segmented (butterflies and moths)		<b>Lepidoptera</b>
13'	Wings not covered with scale, though they may be hairy (Figure 16); mouth parts not in the form of a coiled tubelike tongue; antennae of various kinds	<b>14</b>	
14(13')	Wings long and narrow, veinless or with only one or two veins, fringed with long hairs (Figure 16); tarsi (Figure 17) with only 1 or 2 segments, the last segment swollen; very small insects, usually less than 1/8-inch long (thrips)		<b>Thysanoptera</b>
14'	Wings not as above; if wings are somewhat long and narrow, then the tarsi have more than 2 segments	<b>15</b>	
15(14')	Hind wings smaller than front legs (Figure 18), usually with few veins	<b>16</b>	
15'	Hind wings as large as or larger than front wings, with as many or more veins (Figure 19)	<b>20</b>	



Figure 20

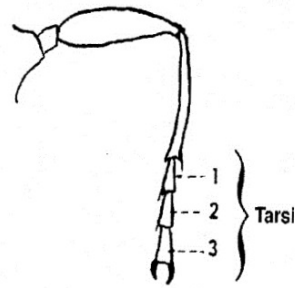


Figure 21

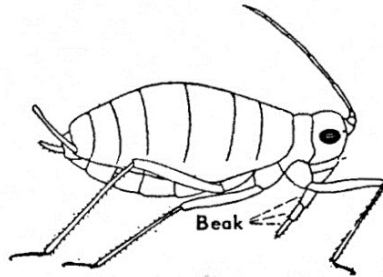


Figure 22

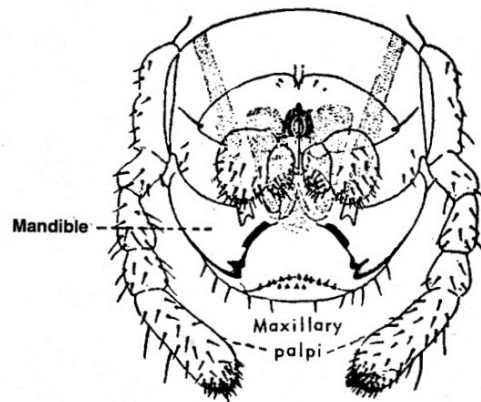


Figure 23

Step	Characteristics	Go on to this step	Order, Suborder
16(14')	Front wings with many cross-veins and cells; antennae short, bristlelike, small; abdomen with two or three long, threadlike cerci (Figure 9); delicate, soft-bodied insects (mayflies)		<b>Ephemeroptera</b>
16'	Front wings with few cross-veins and cells (Figure 20); antennae fairly long, or if short and bristlelike, then there are no threadlike cerci	<b>17</b>	
17(16')	Tarsi 2 or 2 segments (Figure 21)	<b>18</b>	
17'	Tarsi 4 or 5 segments	<b>19</b>	
18(17)	Mouth parts sucking, the beak rising at rear of head (Figures 4 and 22) (leafhoppers, cicadas, aphids, treehoppers)		<b>Hemiptera</b> , suborders Auchenorrhyncha and Sternorrhyncha
18'	Mouth parts chewing (Figure 23), very small insects (book lice, bark lice, psocids)		<b>Psocoptera</b>

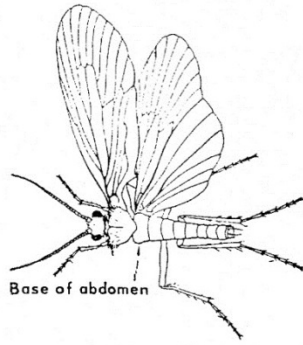


Figure 24

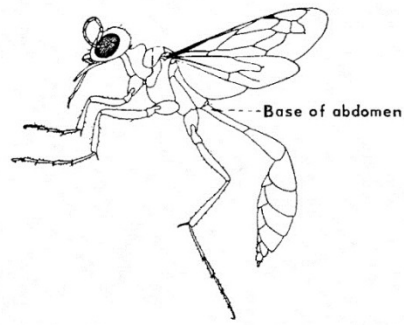


Figure 25

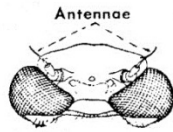


Figure 26

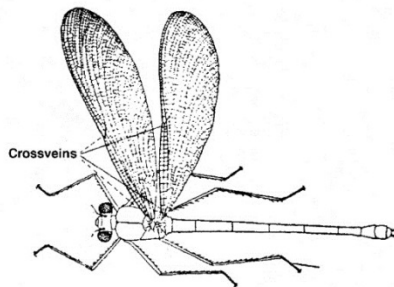


Figure 27

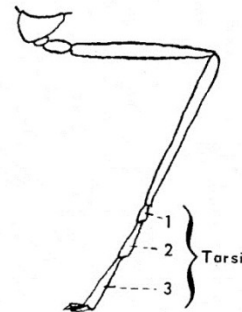


Figure 28

Step	Characteristics	Go on to this step	Order, Suborder
19(17')	Wings noticeably hairy; mouth parts usually very small except for the palpi; antennae usually as long as the body or longer; veins in front and hind wings similar; abdomen not narrow at the base; rather soft-bodied insects, not wasplike (Figure 24) (caddisflies)		<b>Trichoptera</b>
19'	Wings apparently not hairy; mandibles well developed; antennae shorter than the body; fewer veins in hind wings than in front wings; abdomen usually narrow at base (Figure 25); rather hard-bodied, wasplike insects (sawflies, ichneumon flies, ants wasps, and bees)		<b>Hymenoptera</b>
20(15')	Tarsi 3 or 4 segments (Figure 21)	<b>21</b>	
20'	Tarsi 5 segments	<b>23</b>	
21(20)	Antennae short, bristlelike and small (Figure 26); wings with many cross-veins, never held flat over the abdomen when at rest ( Figure 27); tarsi three-segmented (Figure 28); body long and slender, $\frac{3}{4}$ to $3\frac{1}{2}$ inches long (dragonflies, damselflies)		<b>Odonata</b>
21'	Antennae long and conspicuous; wing veins variable, usually held flat over abdomen when at rest; $1\frac{1}{2}$ inches long or less	<b>22</b>	

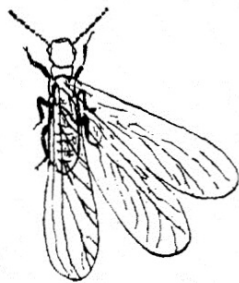


Figure 29

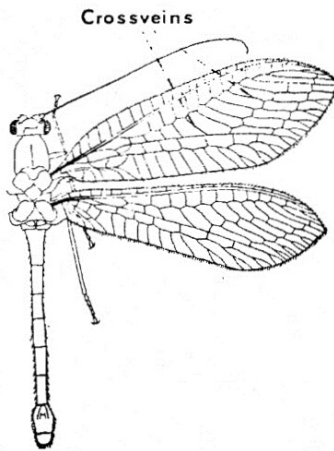


Figure 30

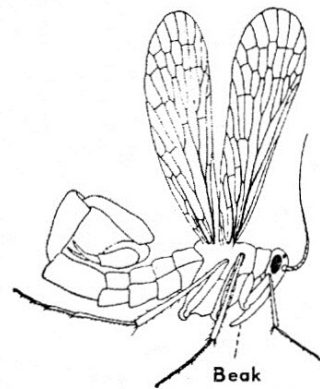


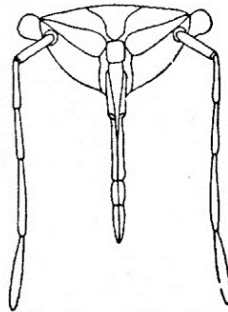
Figure 31

Step	Characteristics	Go on to this step	Order, Suborder
22(21')	Front and hind wings similar in shape, size, and number of veins, reaching well beyond the tip of the abdomen when at rest (Figure 29); no cerci; body $\frac{5}{16}$ -inch long or less (termites)		<b>Isoptera</b>
22'	Hind wings with the rear area much enlarged and folded fanlike when at rest; cerci present; bodies mostly $\frac{5}{8}$ to 2 inches long (stoneflies)		<b>Plecoptera</b>
23(22')	Front edge of front wings with many cross-veins (Figure 30); mouth parts not formed into a beak (as in Figure 31) (fishflies; dobsonflies, lacewings, ant lions)		<b>Neuroptera</b>
23'	Front edge of front wings with not more than one or two cross-veins; mouth parts extended downward to form a "beak" (Figure 31) (scorpion flies)		<b>Mecoptera</b>
24(1')	Usually parasites; body more or less leathery, and flattened from the upper to lower sides of body or from side to side	<b>25</b>	
24'	Free-living, not parasitic; body usually not flattened or leathery	<b>30</b>	



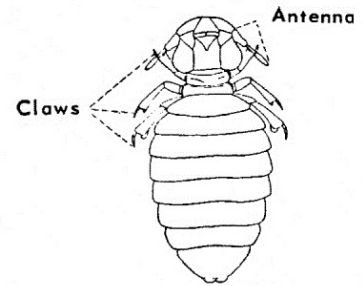
**Chewing mouthparts**

*Figure 32*

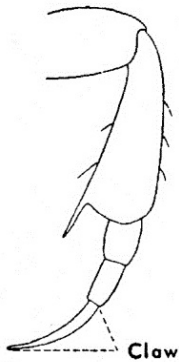


**Sucking mouthparts**

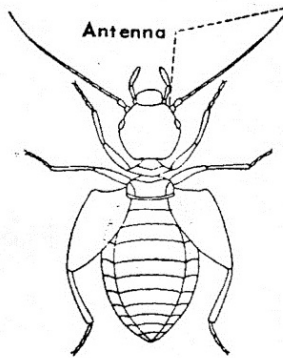
*Figure 33*



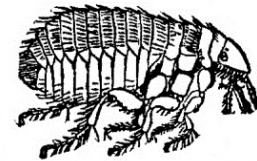
*Figure 34*



*Figure 35*



*Figure 36*



*Figure 37*

<b>Step</b>	<b>Characteristics</b>	<b>Go on to this step</b>	<b>Order, Suborder</b>
25(24)	Mouth parts chewing (Figure 32)	<b>26</b>	
26(25)	Mouth parts sucking (Figure 33), sometimes beak or stylet is drawn up into the head and cannot be seen	<b>27</b>	
26(25)	Antennae with five or fewer segments (Figure 34); tarsi with one claw (Figure 35), parasites of animals, or with two claws, parasites of birds (chewing lice)		<b>Phthiraptera,</b> suborder Mallophaga
26'	Antennae with more than five segments (Figure 36); not parasitic (booklice, barklice, psocids)		<b>Phthiraptera,</b> suborder Psocoptera
27(25')	Body flattened on the sides (Figure 37); jumping insects (fleas)		<b>Siphonaptera</b>
27'	Body flattened from upper to lower sides; not jumping insects	<b>28</b>	



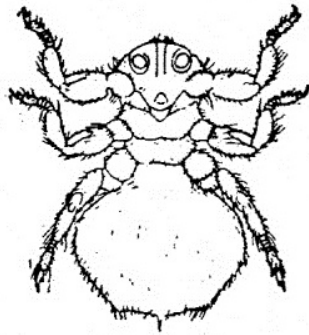


Figure 38

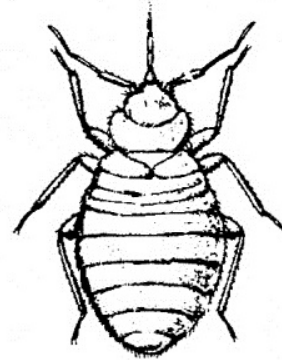


Figure 39

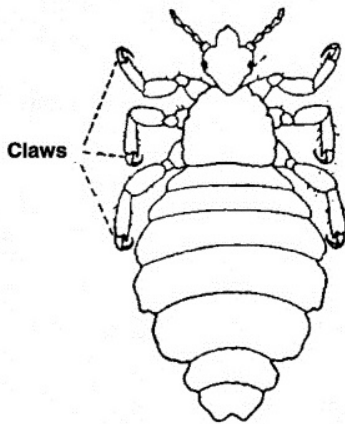


Figure 40

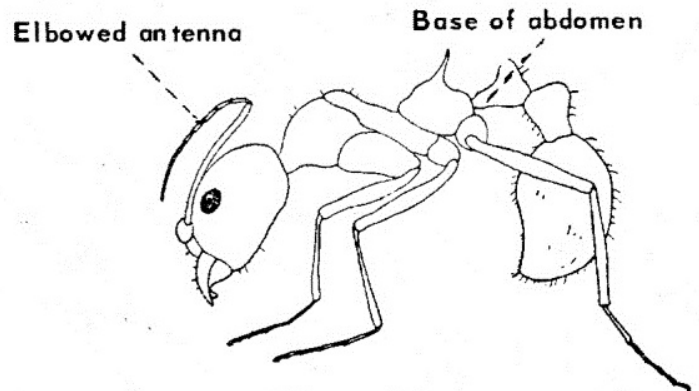


Figure 41

Step	Characteristics	Go on to this step	Order, Suborder
28(27')	Antennae hidden in grooves beneath the head (Figure 38) (louse flies)		<b>Diptera</b>
28'	Antennae not hidden, usually easy to see	<b>27</b>	
29(28')	Beak longer than wide, four segments (Figure 33), extending back beneath the body; tarsi with two small claws (Figure 39) (wingless bugs)		<b>Hemiptera</b>
29'	Head with only a short snout in front, the stylet pulled back into the head when not in use; tarsi with one very large claw (Figures 35 & 40) (sucking lice)		<b>Phthiraptera,</b> suborder Anoplura
30(24')	Abdomen very thin, small, or narrow at base (Figure 41); antennae usually elbowed (Figure 41); hard-bodied, ant-like insects (ants, wingless wasps, velvet ants)		<b>Hymenoptera</b>
30'	Abdomen not particularly thin at base; antennae not elbowed	<b>31</b>	

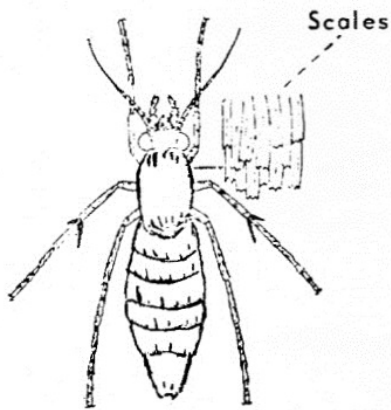


Figure 42

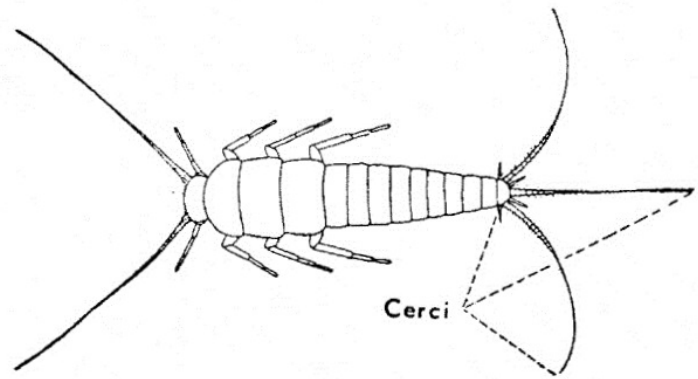


Figure 43

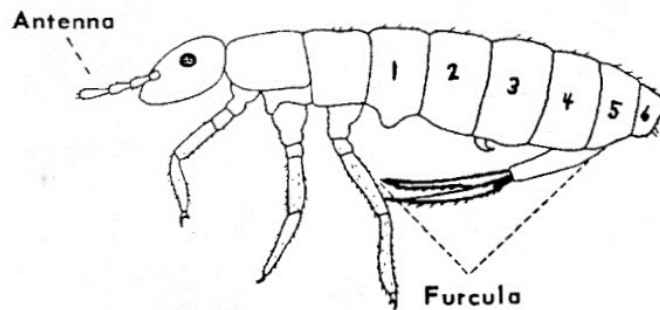


Figure 44

Step	Characteristics	Go on to this step	Order, Suborder
31(30')	Body covered with scales (Figure 42)	32	
31'	Body not covered with scales	33	
32(31')	Abdomen with three long, threadlike cerci (Figure 43), and with spinelike hairs or spikes on some abdominal segments; mouth parts chewing (silverfish, bristletails, firebrats)		<b>Thysanura</b>
32'	Abdomen without tails or spinelike hairs (Figure 42); mouth parts sucking, usually in the form of a long, coiled, threadlike tube or tongue (Figure 15) (wingless moths)		<b>Lepidoptera</b>
33(31')	Mouth parts hidden within the head; abdomen with spine-like hairs on some segments, or with a furcula near the end of the abdomen (Figure 44); usually less than 1/4-inch long	34	
33'	Mouth parts not as above, easily seen, and either sucking or chewing; size variable	35	

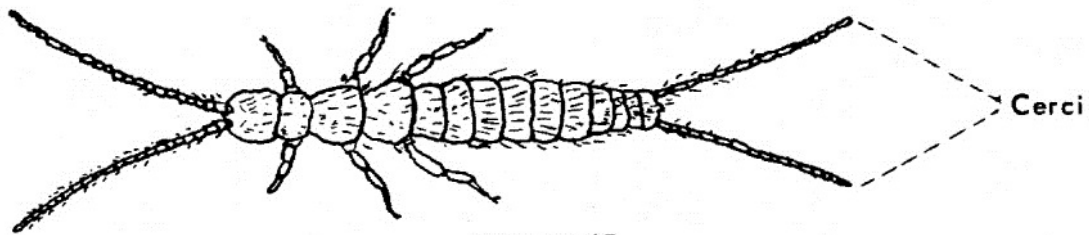


Figure 45

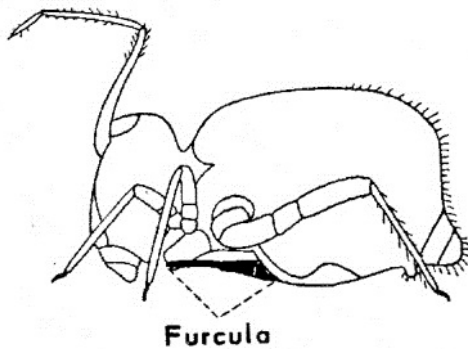


Figure 46

Chewing mouthparts



Figure 47

Step	Characteristics	Go on to this step	Order, Suborder
34(33')	Antennae long and with many segments; abdomen with at least 9 segments, with spinelike hairs on some segments; without a furcula near the end of abdomen, but with 2 short to long, forcepslike cerci at the end of the abdomen (Figure 45) (japygids, campodeids, projapygids). These insects are light-colored, about ¼ inch or less, and are found in damp places under bark, stones, or fallen trees, in rotting wood, etc.		<b>Thysanura</b>
32'	Antennae short, with 6 or fewer segments; abdomen with 6 or fewer segments (Figure 44), usually with a furcula beneath or near the end of the abdomen (Figures 44 & 46) (Springtails)		<b>Collembola</b>
35(33')	Mouth parts sucking, with beak long and pointing backward from the head, or cone-shaped and pointing downward (Figure 33)	<b>36</b>	
35'	Mouth parts chewing (Figure 47); if beaklike, then the beak is fairly long and pointed downward (Figure 50)	<b>38</b>	

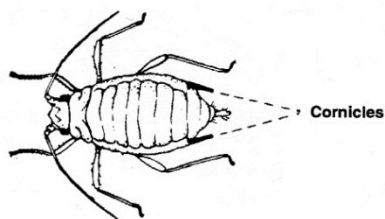


Figure 48

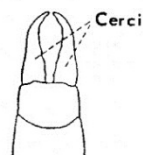


Figure 49

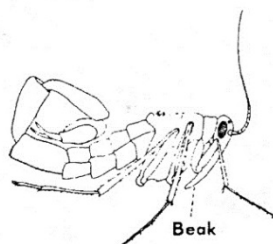


Figure 50

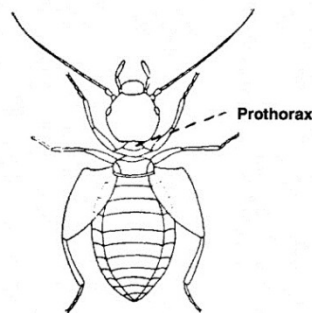


Figure 51

Step	Characteristics	Go on to this step	Order, Suborder
36(35)	Body long and narrow; tarsi with 1 or 2 segments and often without claws (Figure 17); beak cone shaped; very small insects, usually less than $\frac{1}{8}$ -inch long (Figure 16) (thrips)		<b>Thysanoptera</b>
36'	Body usually more or less oval; tarsi usually 3-segmented (Figure 28), with well-developed claws, size variable	<b>37</b>	
37(36')	Beak arising from rear under part of head (Figures 4 & 22); abdomen often with a pair of cornicles (Figure 48) (aphids)		<b>Hemiptera</b> , suborders Auchenorrhyncha & Sternorrhyncha
37'	Beak arising from front part of head (Figures 1 & 3); abdomen without cornicles (wingless bugs)		<b>Hemiptera</b> , suborder Heteroptera
38(35')	Cerci forcepslike (Figure 49) (earwigs)		<b>Dermaptera</b>
38'	Cerci absent, or if present, then not forcepslike (Figure 52)	<b>39</b>	
39(38')	Mouth parts in the form of a beak pointing downward (Figure 50); tarsi 5 segments (Figure 54); insect usually less than $\frac{5}{16}$ -inch long (Figure 50) (wingless scorpion flies)		<b>Mecoptera</b>
39'	Mouth parts not as above; tarsi and size of insect variable	<b>40</b>	

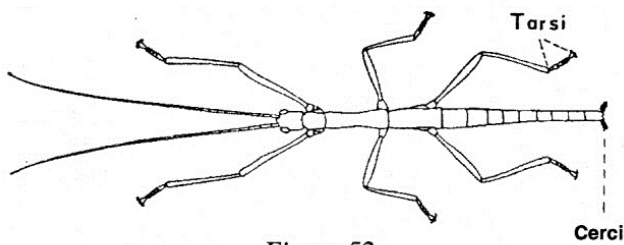


Figure 52

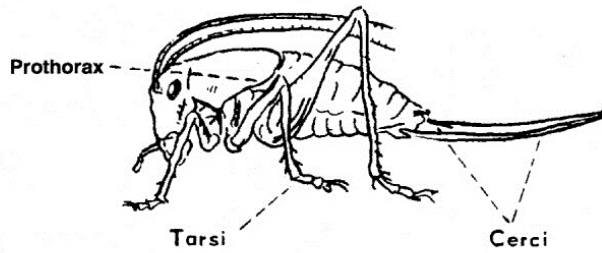


Figure 53

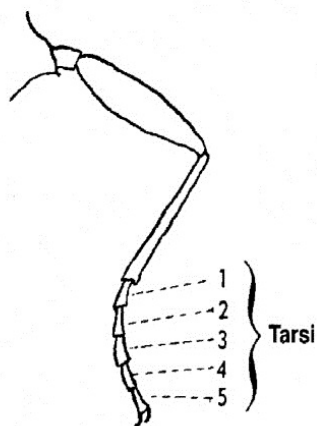


Figure 54

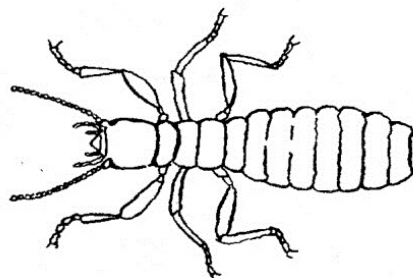


Figure 55

Step	Characteristics	Go on to this step	Order, Suborder
40(39')	Small louselike insects (Figure 51) less than $\frac{3}{16}$ -inch long; no cerci; tarsi 2-3 segments; prothorax (Figure 51) very small (booklice, barklice)		<b>Psocoptera</b>
40'	Not louselike, insect usually more than $\frac{3}{16}$ -inch long; tarsi 3-5 segments; cerci present (Figures 52 & 53); prothorax large (Figure 53)	<b>41</b>	
41(40')	Hind legs are large, fitted for jumping (Figure 53); tarsi 4 or fewer segments (crickets and grasshoppers)		<b>Orthoptera</b>
41'	Hind legs not large, not fitted for jumping (Figure 52); tarsi 4- or 5-segmented	<b>42</b>	
42(41')	Tarsi 4 segments; whitish, soft-bodied, living in wood or ground; insect $\frac{5}{16}$ -inch long or less (Figure 55) (termites)		<b>Isoptera</b>
42'	Tarsi 5 segments; appearance not as above (Figure 52) (walkingsticks)		<b>Phasmatodea</b>

**PURPOSE**

To develop an understanding of the diverse food habits, the diverse environments, and the diverse behaviors of insects.

**OBJECTIVES**

Youth will be able to:

- ◆ identify which foods are preferred by which insects
- ◆ observe and collect different insects from diverse habitats
- ◆ describe the correlation between insect external anatomy and its habitat

**LESSON TIME**

Lesson time will vary upon learning activities selected. Time will vary from a few minutes to collecting trips.

**LEARNING ACTIVITIES**

Getting Into Galls  
Dipping for Aquatic Insects  
Who Lives Here  
Activity Ideas on Where to Collect Insects

**ADVANCED PREPARATION**

- ◆ Review Where to Collect Insects - Background Basics
- ◆ Use Background Basic Ideas for collecting trips
- ◆ Review each activity and determine choices for your age group
- ◆ Collect and prepare materials or have 4-H members collect and prepare materials

## BACKGROUND BASICS

Making an insect collection enables youth to learn more about the diverse species of insects that live around them.

The trick to making a large and varied insect collection is knowing the food habits, the behavior, and the habitat of the insects.

Their Food Habits

Remember one of the characteristics between insects orders was type of mouthparts. The kind of mouthpart will dictate what they can eat, and their food habits.

Where They Live

An animal's home is called its habitat. Insects live in habitats that provide them with acceptable food, shelter, water, space to make, lay eggs, and grow. An insect's external anatomy gives a clue as to where it can live.

How They Live

Each habitat supports only those animals adapted to its living conditions. (Hint: some aquatic insects are sleek with powerful legs for swimming).

Whenever insects are collected, the date and where it was caught should be recorded to make the specimen a piece of scientific information. The following are ideas of where to look and collect insects throughout the year.

**FROM SPRING UNTIL FALL:**

1. Observe blooming plants. Many insects feed on nectar or pollen.
2. Observe foliage and twigs of plants, especially on warm days. Sweep or beat the foliage.
3. Collect around ponds, running streams, lakes and wet land area.
4. Collect directly in the water and along the water edge.  
Turn over stones or use an aquatic net to strain water around vegetation in the water.
5. Use collecting net. Many insects can be swept from the air on warm sunny days.
6. Turn over stones, sticks, logs and debris.
7. Remove loose bark and break apart rotting stumps or logs.
8. Observe street lights, illuminated store windows or porch lights at night. Visit such areas at different hours during the evening.
9. Examine domestic animals and poultry for parasites.
10. Turn over animal droppings, decaying matter, including dead animals and birds.
11. Look on a variety of vegetation, fruits and vegetables, both day and night.
12. In the soil, especially around the roots of plants.



## During the Winter:

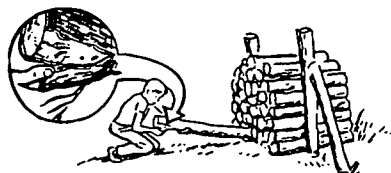
### *Hibernating insects out-of-doors:*

1. Many insects can be found hibernating under bark of trees, in rotten logs, in trash and compost heaps.
2. Clumps of grass are excellent material to collect overwintering insects. Cut off an inch below ground level, place in paper bags and hold at room temperature for a few hours. Then dump out and collect the insects.



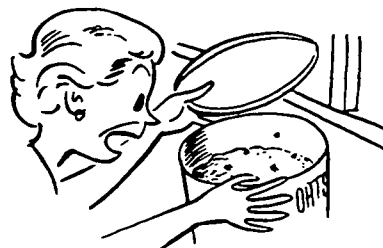
### *In Homes:*

1. Carpet beetles: Black, varied, furniture or common carpet beetle adults or larvae may be found in rugs, closets, dresser drawers or around windows.
2. Clothes Moths: Webbing and case bearing clothes moths and larvae may be found in same areas as listed above.
3. Silverfish: Silverfish or firebrats may be found on bath tubs, kitchen sinks, wash basins, on book shelves or places where books are stored.
4. Roaches: American, German, Oriental or brown banded cockroaches may be found in kitchens, bath rooms, basements or other parts of the house.
5. Cereal insects: Confused flour beetles, saw-toothed grain beetles, cigarette beetles, drug store beetles, bean weevils, Indian meal moths or Mediterranean flour moths may be found in flour, spices, corn meal or cereal products stored in kitchen cabinets.
6. Hibernating insects: Cluster flies, face flies, wasps, boxelder bugs, elm leaf beetles may be found in attics, vacant rooms or inside of windows on sunny side of house.
7. Ants: Carpenter ants, larger yellow ants, thief ants or others are in or around the home.
8. Cerambycids: Many species may be in fire place wood stored in the home.
9. Powder post beetles: Watch for sawdust being worked out of joists, flooring or sills.
10. Swarming insects: Subterranean termites or ants swarm in or near homes during early spring.



### *In Barns:*

1. Species of lice on cattle, hogs or poultry.
2. Sheep tick or ked on sheep.
3. Flies around windows.
4. Cereal pests - Meal worms, granary, rice weevils, sawtoothed grain beetles, confused flour beetles, Mediterranean flour moths, Indian meal moths, Angoumous grain moths, cadelle beetles in grain bins or feed rooms.





**In Ponds:** Below are descriptions and pictures of common aquatic insects you may find in ponds.



### DIVING BEETLE

**Appearance:** This beetle is big, streamlined and oval-shaped. It has long hind legs, which it moves together at the same time like oars as it swims rapidly through the water.

**Food:** Insects and soft-bodied creatures such as several kinds of worms, insect larvae and tadpoles.

**Notes:** Like all typical insects, the diving beetle gets its air from tiny tubes, or *tracheae*, inside its body. This air is continuously replenished from an air bubble carried under its wings. Every so often, the diving beetle must get a fresh bubble by visiting the surface. Fish will readily eat this beetle, so it usually swims close to water plants for protection.



*Diving beetle*



### WATER BOATMAN

**Appearance:** The water boatman is streamlined for underwater swimming. Each of its flattened, hairy swimming legs is like the blade of an oar, "rowing" the boatman quickly through the water. The boatman looks similar to the backswimmer, a water bug that may bite you if you handle it.

**Food:** Small pond creatures.

**Notes:** The water boatman carries air beneath its wings and also in special hairs on the underside of its body. This film of trapped air appears silvery. Like the diving beetle, the boatman must come to the surface at intervals to replenish its air supply.



*Water boatman*

### WHIRLIGIG BEETLE

**Appearance:** This insect is oval-shaped and usually black. It has extremely short antennae, long forelegs and short, paddle-like hind legs.

**Food:** Small insects, taken both on and below the surface of the water.

**Notes:** Whirligig beetles were named for their habit of spinning crazily around in circles on the water's surface. Look for this activity near the water plants at the edge of a pond or quiet stream. The eye of the whirligig beetle is divided into an upper and lower part so that the insect can see above and below the water at the same time.



*Whirligig beetle*

## COMMON AQUATIC INSECTS

### WATER STRIDER



*Water strider*

**Appearance:** The water strider is slender, with long, thin legs. The weight of the body is evenly spread out to keep the bug from sinking below the surface. Thus it runs easily on top of the water.

**Food:** Chiefly insects that fall onto the water's surface and cannot fly off again.

**Notes:** Also known as "pond skaters," water striders secrete a type of oil from their foot segments that repels water and keeps their feet dry as they walk on the surface.

### DRAGONFLY LARVAE

**Appearance:** The dragonfly larva has a flattened shape and is solidly built, as it spends most of its time on the bottom of the pond. At the front of its head is a type of "mask," a specialized lower lip with two teeth, which is used for snaring food.

**Food:** Other insects. The larvae lies in wait for a victim to pass or inches slowly toward its prey. Adult dragonflies are among the most skilled of insect fliers; they catch their meals of flying insect in midair.



*Dragonfly larva and adult*

### BUG BOTTLE PROJECT

Look for a dragonfly larva moving slowly on the bottom of a pond, marsh or boggy lake, near the edge.

Pick up the larva and gently place it in your bottle with a little pond water.

The larva is like a jet-propelled submarine. Touch it lightly with a small stick and watch it force water out of the back of its body and shoot forward.

Put in a stick that reaches almost to the lid of the bottle. If you're lucky enough to have a larva that's ready to change form, you'll see it climb up the stick and turn into an adult dragonfly. If so, do not touch its wings and let it go outside as soon as the wings have reached full size and hardened.

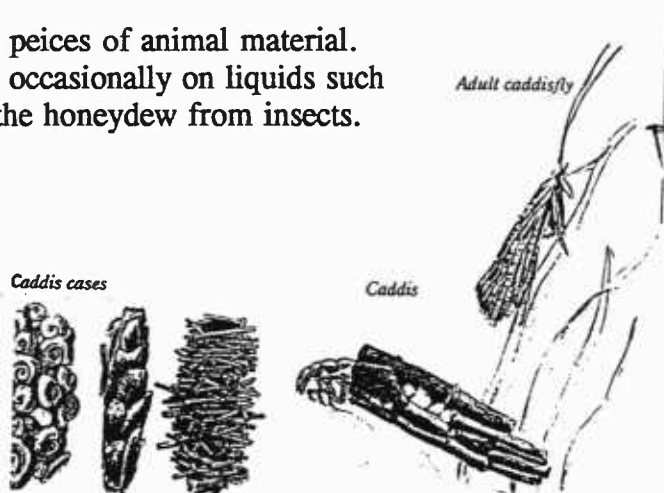
If you keep the larva longer than a week, you will have to feed it. The dragonfly larva eats only living prey, so put a small water bug in the bottle. Watch quietly, and you may see the larva's "mask" in action.

## COMMON AQUATIC INSECTS

### CADDIS

**Appearance:** Caddis, the larvae of caddisflies, look like tiny moving pieces of pond bottom. They carry around miniature houses made of small pieces of leaves, twigs, shells or other items from their surroundings.

**Food:** Little plants or peices of animal material. Some caddisflies feed occasionally on liquids such as flower nectar and the honeydew from insects.



### BUG BOTTLE PROJECT

Look into a clear pond until you see tiny piles of sticks or leaves that seem to move on their own.

Scoop some pond water into your bottle. Then gently pick up a caddis, in its case, with your fingers and quickly add it to the new environment you've created.

Look into the pond again. Is there another type of caddis to catch and add to your bottle?

Very gently pull some of the caddis' house apart *underwater*. Keep in mind that a caddis cannot breathe out of the water.

Look at the feathery hairs over the caddis' body. These hairs are gills that help the larva take in the oxygen dissolved in the water.

Give the caddis tiny pieces of whatever its first house was made of or even pieces of the house itself. Watch it build a new house.

Try giving the caddis a different set of building materials. It may not use the ones you supply, because most larvae build with only one type of material. However, someone once succeeded in getting a caddis to build a house of gold dust!

## **Outdoor Manners**

The philosophy of the Oregon 4-H Environmental Stewardship program is a commitment to be responsible for our surroundings and ensure a quality environment. Before 4-H'ers go out to collect insects, leaders need to discuss outdoor behavior and try to encourage in them a caring attitude about the outdoors, and teach them to be responsible for their actions.

Encourage your group to follow this code:

Get permission to enter a property before collecting especially at parks, campgrounds, and private property.

Restore the habitat to as natural a stage as possible. For example, replace overturned stones or place bark on top of stumps. Don't throw rocks in streams or ponds.

Watch where you swing your net when collecting flying insects.

Keep the lid on your killing jar when not in use.

Don't over collect insects. Keep only a few of one species and only those in their best physical condition.

Be courteous to other wildlife when collecting. Observe other animals without disturbing them or their habitat.

Don't litter and pick up litter left by others.

**OBJECTIVES:** For youth to:

- describe different types of plant galls
- explain how plant galls form
- recognize that galls provide a home for developing insects

**MATERIALS:**

- mesh screen for gall catcher
- sturdy thread and needles
- sharp knife

**TIME:** depends on your hikes to find galls on plants or trees

**BACKGROUND INFORMATION**

Galls are those strange-looking swellings you often see on plants. They come in all shapes, sizes, and colors, from pink, round and woolly to flat and spiny. Galls can be caused by many different things, such as fungi, nematode worms, or mites. But many of the common types of galls are caused by insects.

You can find galls on different kinds of plants and on different parts of plants. Some are found on flowers, leaves, stems, bark, and roots.

An insect gall forms when a female insect lays her eggs in a plant. When an egg hatches, the larva that comes out secretes a special chemical that causes the plant part to grow in a weird, unnatural way.

Certain moths, wasps, and flies are the most common gall makers and each species makes a differently shaped gall. The gall provides food, shelter, and water for the growing larva. Many larvae will eat and grow inside the same gall during the summer, pupate in the winter, and emerge as adults the following spring.

To take a closer look at galls, search with your group for galls on trees, shrubs, and flowers. (Oak, willow, hickory, cottonwood, poplar, and cherry are good trees to search; blackberry, rose and goldenrod are also gall-forming plants.)

When you find a gall, have the member look to see if there is a tiny hole on the outside of it. If there is, the adult has probably already emerged. If not, you can watch the gall and find out what insect made it.



The best way to see galls "hatch" is to leave them outside on the plant and make a gall catcher out of mesh wire screen. Sew the screen cage around the gall to form a basket. Check your trap every day, if possible. When the adult crawls out of the gall it will be trapped inside the screen. Watch the insect up close through the screen and see if you can tell what kind it is. (Many gall insects are very tiny.) You can also try to bring the gall inside. Put the cut end of a leaf or twig in water so the plant stays alive, and set it inside a glass tank that has a screened-in top. Watch it every day to see what comes out. You can also cut open large galls, such as oak-apple and goldenrod, to show your members the developing larvae.

It may be that the emerging insect is not the one that made the gall. Many species of insects do not make galls themselves, but lay eggs in galls made by other types of insects. And many insects are parasites on gall insects, laying eggs on the gall insect larvae.

**OBJECTIVES:** For youth to:

- identify aquatic insects
- describe how aquatic insects are adapted for living in the water

**MATERIALS:**

- a muslin net, small cup or scooper
- white baking dishes, bowls, or any white-bottomed collecting pan

**TIME:** depends on the closest water source to collect and observe in the field

**BACKGROUND INFORMATION**

Insects that live in water have special ways of swimming, breathing and obtaining food. Some insects live in ponds all their lives. Others live underwater only during their larvae stage, which usually lasts longer than the adult stage. When the adults emerge, they live outside the pond but come back to it to lay eggs. Look for aquatic insects both above and below the water.

At the end of this lesson are reference sheets on identifying the most common aquatic pond insects.

In order to watch and study aquatic insects up close, you need to catch some--and dip nets work great! Dip the net into the pond or stream, being sure to scoop up some bottom mud and water plants. In a stream, place your net just downstream of a rock as you lift the corner of the rock. Some of the critters hiding under the rock may be washed into the net. Children can do this alone or they can work in pairs. (Put the rocks back in place when you are through).

Sift through the net by hand, searching for insect larvae, nymphs, and adults. Also look for insect eggs attached to plants and floating twigs.

For a better look, dump the contents of the dip net into a white pan. The insects will crawl around and be easier to spot against the white background.



You can also make a strainer dip stick by fastening the handle of a large kitchen sieve to a broom stick or long pole. Fasten it securely with duct tape or plastic insulation tape. (This kind of net is best for straining the water. It's not strong enough for scooping up things from the bottom).

**Note:** Make sure to return all insects to the water when the activity is over.

**OBJECTIVES:** For youth to:

- describe five places where insects live
- give examples of insect food, of insect shelter, of where insects lay eggs, of insect relations and/or predators

**MATERIALS:**

- copies of Insect Bingo Sheet
- cardboard or heavy paper (8½" x 11")
- clear contact paper (optional)
- grease pencil (optional)
- scissors
- pencils

**TIME:** depends on location of hiking areas**SUGGESTIONS:**

If other habitat items are more common in your area, make your own bingo square and substitute it into the game.

Insect Bingo is an exciting way to investigate insect habitats. Make enough copies of the bingo chart for each person in the group to have one. Also, pass out scissors, glue, and cardboard. Now have each member make up a game card, or "bug board," by cutting apart the chart squares and pasting them in a new arrangement on their sheet of paper or cardboard. (Each card will have the same items, but the items will be arranged in a different order.)

Now take a walk on a nature trail or other hiking areas. Have the youth look for the items and insects that are shown on their sheets. When someone spots something on the sheet, discuss it in relation to an insect's habitat. For example, if a dragonfly is spotted, ask the members what it might eat or where it takes shelter in case of a storm. Or why it needs to live close to water. (Dragonflies lay their eggs in or near the water, and the nymphs that hatch live underwater in rivers, ponds, and lakes). If someone sees an insect home, discuss how that home provides food, water, shelter, and a place to lay eggs for a particular type of insect. Also, talk about the different types of insects that might live there.



Have everyone put an X over the things on his or her board as they are spotted. The first person to get a whole line crossed (up, down, diagonally) wins the game.


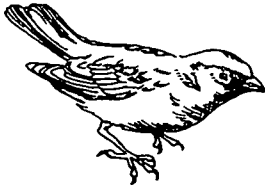

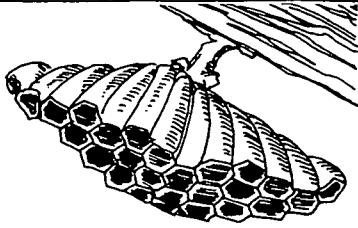

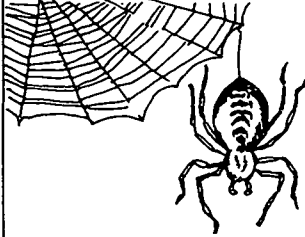

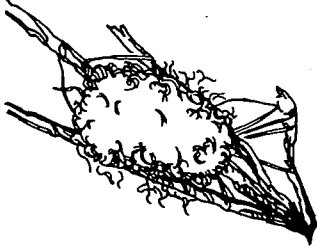

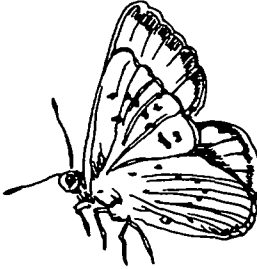

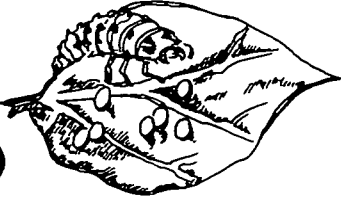

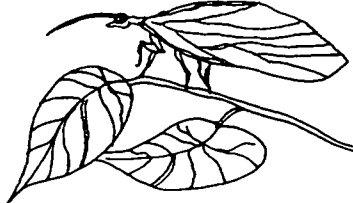

To make the cards permanent and reusable, have the youth paste the squares onto heavy cardboard. Laminate the cards or cover them with clear contact paper. Then have them use special grease pencils to X the squares so that the Xs can be easily wiped off and the cards used again.



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# INSECT BINGO



 <p>ANT</p>	 <p>INSECT PREDATOR</p>	 <p>INSECT EGG CASE</p>	 <p>INSECT HOME</p>
 <p>INSECT FOOD</p>	 <p>INSECT RELATIVE</p>	<p>FREE SQUARE</p>	 <p>GALL</p>
 <p>COCOON</p>	 <p>BEE</p>	 <p>BUTTERFLY</p>	 <p>INSECT DAMAGE</p>
 <p>INSECT EGGS OR LARVAE</p>	 <p>GRASSHOPPER<sup>8</sup></p>	 <p>INSECT CAMOUFLAGE</p>	 <p>WATER INSECT</p>

**OBJECTIVES:** For youth to:

- locate insects in certain habitats
- identify the insect, know the common name
- describe what the insect eats in the habitat

**MATERIALS:**

- Who Lives Here Worksheet
- Insect Field Guide or textbooks
- pencils and colored markers

**TIME:** depends on location of the microhabitats

**SUGGESTIONS:**

Substitute other micro habitats that are easily found in your area.

**BACKGROUND INFORMATION**

There are many different kinds of major habitats in the world, such as forests, mountains, streams, deserts, swamps, rivers, tundra, and seashores. But in each of these large habitat areas there are many smaller *microhabitats* that support many different types of creatures, especially small animals. For example, in a forest habitat, some insects spend their entire lives in the leaf litter on the forest floor or inside a rotting log. Each is considered a microhabitat of the forest because each provides food, shelter, water, and enough space for the insects' needs.

To get your members thinking about microhabitats and where insects live, pass out copies of the "Who Lives Here?" worksheet. (You can have the youth work in teams or individually.) The object is to find a type of insect that lives in each microhabitat listed on the left side of the worksheet. Then they have to fill in the name of the insect and what it eats and draw a sketch of the insect.

Many different insects live in each microhabitat, so everyone's chart will have different answers. If you want to be more specific, you can fill in the column "What It Eats" before you hand it out.

Give each person (or team) time in the library to learn to use simple field guides and insect reference books to find out where insects live and what they look like.

When everyone has finished, go through the list and discuss each habitat area and how it fills the needs of each insect. Compare the insects listed for each habitat. How are they the same? How are they different? Ask the kids why insects that live in the same microhabitat eat different things. (In that way they don't compete for limited amounts of food.) You can also discuss how each insect is especially adapted to living in a certain microhabitat. (mole crickets: digging legs, chewing mouthparts; praying mantid: grasping front legs, chewing mouthparts; fleas: sucking mouthparts, flattened bodies for squeezing between animals' hairs).



WHERE IT LIVES	ITS NAME	WHAT IT EATS	WHAT IT LOOKS LIKE
In a tree	Acom weevil	Acoms	A detailed line drawing of an acorn weevil, showing its characteristic long snout and striped elytra.
In tall grass			
In a garden			
On a cactus			
In your house			

**OBJECTIVES: To:**

- provide more activities for youth to collect insects

**MATERIALS:**

- depends on activity idea

**TIME:** depends on activity idea

**SUGGESTIONS:**

depends on activity idea

1. Plan a field trip to two or three different habitats - stream-side, grassland with flowers, wooded area, etc. Before you get there you can ask them to predict what types of insects they think they will find in that habitat. Have the group develop a list of the insects they catch (or see) within each habitat and compare these with their predictions.
2. Have the members present information on the food habits, life cycle, and habitat of an insect that interests them. Have them explain how knowing this information would be helpful to a collector or observer.
3. Have members share their experiences of insects they have seen in the past. (Have them describe the habitat and what the insect was doing at the time they saw it).

**PURPOSE**

To inform members of the varied techniques available to collect insects from their habits.

**OBJECTIVES**

Youth will be able to:

- ◆ use the best technique appropriate for the insect
- ◆ increase the diversity of their collection by using different techniques

**LESSON TIME**

Lesson time will vary upon which technique you want to demonstrate or use and which equipment you want to make.

**LEARNING ACTIVITIES**

None. This section is a discussion on the various collection techniques available to the members.

**ADVANCED PREPARATION**

- ◆ Review the discussion, make copies for club members
- ◆ Ask members to collect materials to make appropriate equipment when needed

## BACKGROUND BASICS

Insects can be found everywhere: in the air, water, or soil; on the plants and animals or in buildings. Several techniques are used to collect insects from their different habitats.

**Sweeping**

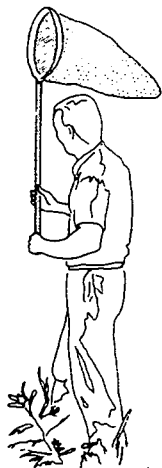
The quickest way to collect insects out-of-doors is to sweep weeds and plants around the yard, in pastures or on road sides. This simply means swinging a collecting net through the plants, picking the insects from the net and putting them in a jar with a killing agent.

Use tweezers to pick the insect out of the net or place the lip of the jar under the insect as it crawls up the inside of the net. Let the insect drop into the jar.

**Collecting Flying Insects**

For butterflies, moths, flies, wasps, dragonflies and other fast-flying insects a butterfly net is easier to use than a sweep net. The butterfly net is light, easily maneuvered and the captured insects

can be seen through it. Butterflies and moths (Lepidoptera) are very delicate. Wing scales and body hairs are easily rubbed off. When captured immobilize them immediately by lightly pinching the thorax through the net. This stuns them and reduces the loss of wing scales.

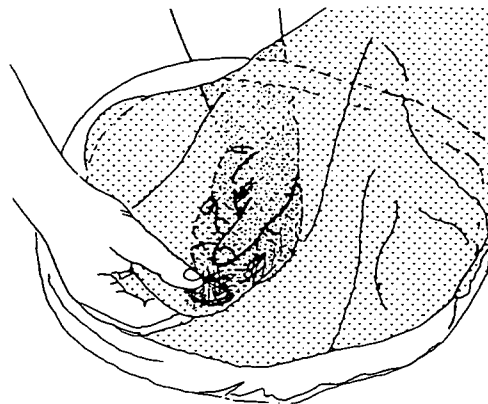


Place them in a wide-mouth killing jar. Do not leave butterflies in the killing jar longer than necessary. Do not add other live insects, which might crawl around, while the butterflies or dragonflies are in the jar. Remove them from the killing jar after their death and place them in small envelopes or in a holding jar. Place in an ice chest to keep cool.

**Hand Collecting**

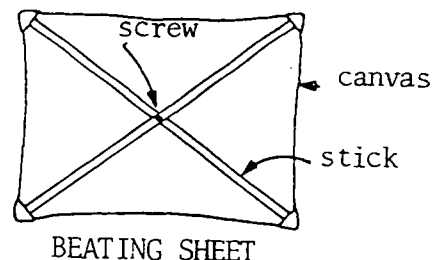
Insects that crawl about in "runs" or depressions under stones and fallen logs are collected by hand. Insect pupae, beetle grubs and other immature insects are frequently found there or they may be under the loose bark of logs. Collect these

insects by picking them up with fingers, tweezers or they may be run into the killing jar. Larvae, nymphs, soft-bodied adults are put in the alcohol vials directly.



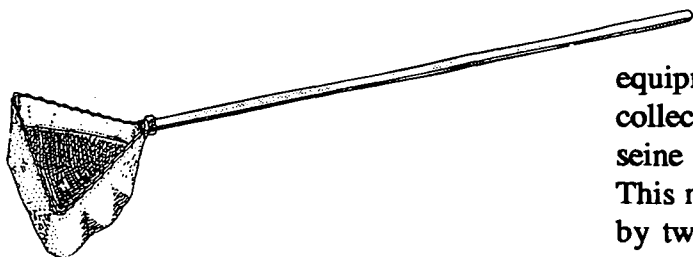
**Beating**

A common collecting method is to lay a sheet of cloth or canvas (white is best) around the base of a shrub or small tree and shake the foliage or beat it with a stick. Many insects have the habit of immediately dropping to the ground when they are disturbed. They are easily picked from the cloth and placed into the killing jar.

**Aquatic Collecting**

Collecting insects from ponds and streams requires extra equipment. A manufactured aquatic net is expensive to buy. Make one from inexpensive materials. The handle should be heavy like a hoe, rake handle or a piece of one-inch aluminum tubing. The net ring is made of one-fourth inch steel rod bent into a triangular shape and attached in the manner shown for net handle construction. The bag must withstand rough treatment, so make it from sturdy material such as the mesh of a seine. Protect the bag by a light

canvas apron. This net is used for scraping along gravel or mud on stream bottoms. It is probably easiest to buy the net bag from a biological supply house and to construct the frame to fit.



Another piece of equipment for aquatic collecting is a fine mesh seine or mosquito netting. This net is held downstream

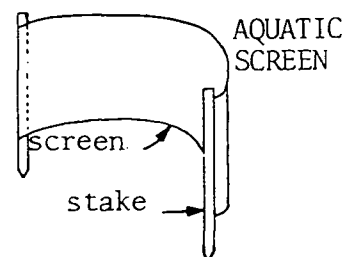
by two people while a third person works their way upstream, kicking rocks and gravel loose with his feet. Pick up large stones and dislodge the insects. The insects will be washed downstream into the net.



A flour sieve or a small tea strainer is handy in small isolated areas around pond margins.

Splashing water up on pond banks usually brings sand- and mud-burrowing insects to the surface.

The aquatic setting harbors many beetles (Coleoptera) and bugs (Hemiptera) in the adult stage. This is also the habitat of the immature forms of dragonflies, damselflies, stoneflies, caddisflies and some of the true flies. Instead of using the regular killing jar, collect all of these insects in 70% alcohol. Later, the immature forms can be placed in separate vials and the adults pinned.



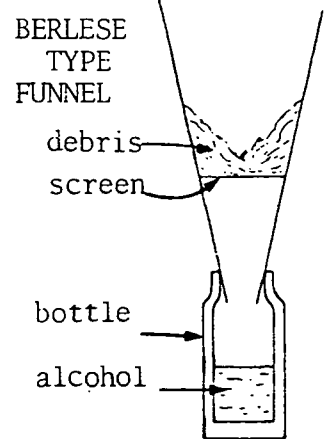
**LESSON 6**

**TECHNIQUES ON HOW TO COLLECT INSECTS**

**Soil Collecting**

Soil-dwelling insects can be difficult to detect and time-consuming to collect. Collecting can be made easier by using a Berlese funnel.

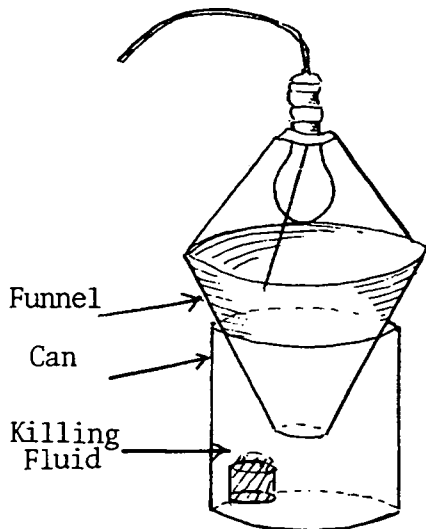
A metal tube or can with a screen attached at the base is set into a bottle or jar filled with some alcohol. The soil sample is placed in the funnel. If a light bulb is attached to the top of the funnel, the heat from the bulb will drive any animals down the funnel and into the alcohol.



**TRAPPING TECHNIQUES FOR COLLECTING**

**Light Traps**

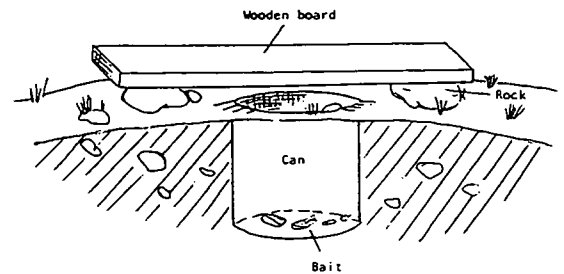
Use an extension cord with light socket. Coat hanger wire may be used as a support for the light. Cut the end from an old funnel and set it loosely in a wide-mouth jar or metal can. Stakes may be necessary for support.



(saturated cotton in a jar)

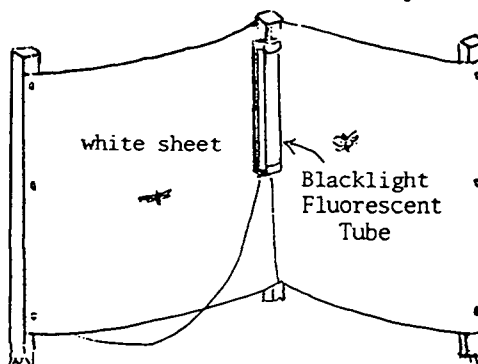
**Pitfall Traps**

Bury a can in the soil. Cover it with a board as illustrated. Bait the can with sliced fruits or vegetables.



**Black Light Trap**

Black lights are made in the same form as fluorescent tube lights and require the same type of fixture. Hang the light on a pole with a white sheet as the reflective surface. Never look directly at an operating black light. The ultraviolet rays produced may injure human eyes. Collect the insects as soon as they land on the sheet.





**PURPOSE**

To provide suggestions to the leader on possible agenda ideas for club meetings throughout the 4-H year.

**OBJECTIVES**

Leader will be able to:

- ◆ provide more organized meetings
- ◆ provide active, hands-on learning activities
- ◆ plan ahead with help from junior leaders, assistant leaders, etc.

**LESSON TIME**

Lesson time involves reading the suggestions and using any that are appropriate. Remember some lessons may take several club meetings to complete, not just one! Also, collecting hikes, field work, any outdoor activities have not been plugged into this agenda. This will expand the schedule.

**ADVANCED PREPARATION**

- ◆ review the suggested program for club meeting ideas
- ◆ decide what topics you want to cover during the year
- ◆ make a flexible schedule of topics per club meeting - include outdoor activities
- ◆ review/study background basics per topic
- ◆ solicit help and ideas from other leaders, junior leaders, club members

## **SUGGESTED PROGRAMS FOR CLUB MEETINGS**

The following outlines are suggestions to the leader who should modify them to fit the needs of the club. This notebook is supplemented with activity sheets which cover many of these topics. The lessons can be taught/used out of order.

### **First Meeting**

1. Open the meeting with a discussion of "What is Entomology?" "What is an Insect?"
2. Discuss the requirements of the project with the members.
3. Have a brief discussion about how entomology fits in with other projects, i.e. forestry, animal project, food.
4. Tell members to bring materials to make an insect killing jar to the next meeting.
5. Have each member bring live insects to the next meeting. Distribute fact sheet, How to Make a Killing Jar.
6. Start Lesson 1 - External Anatomy.

### **Second Meeting**

1. Open the meeting with a demonstration of how to make an insect killing jar.
2. Have members make their own killing jar and kill the insects they brought with them.
3. Continue Lesson 1 - External Anatomy.
4. Show members the parts of an insect and have them identify these parts on the insects they brought.
5. Do Learning Activities in Lesson 1.
6. Tell members to bring materials to construct an insect net and/or display case. Distribute fact sheets.

### **Questions & Review**

1. What is entomology?
2. What does this study include?
3. What is an insect?
4. How are insects beneficial?

### **Third Meeting**

1. Open the meeting with Roll Call by having members name a part of an insect or how to make a killing jar or name their favorite insect.
2. Demonstrate how to make an insect net. Have the members construct their nets. Discuss Lesson 6 - Techniques on How to Collect Insects. Distribute fact sheet.
3. Tell members to bring materials to construct a spreading board at the next meeting.
4. Review Lesson 1 and/or start Lesson 2 - Insects and Their Relations.

## Questions & Review

1. How would you describe an insect? 2. What are the three regions of an insect's body? 3. To what part of the insect are the legs and wings attached? 4. Where is the insect's skeleton? What functions does it serve? 5. How do insects differ from other animals? (Three pairs of legs, compound eyes, exoskeleton, antennae, three distinct body regions.)

## Fourth Meeting

1. Continue with Lesson 2 Activities and Ideas or start Lesson 3 - How Insects Grow.
2. Demonstrate how to make an insect spreading board. Construct an insect spreading board.
3. Show how to spread the wings of a butterfly (see fact sheet). If live butterflies cannot be found at this time of the year, a model can be constructed and used for a demonstration or distribute the fact sheet - How to Pin Adult Insects and demonstrate how to do this.
4. Construct an insect display case, make an insect case out of a cigar box for temporary storage.
5. Tell members to collect four or five large insects in advance of the next meeting.

Note: Have each member obtain a package of size 1 or 2 insect pins. County Extension Office can refer you to a source.

## Questions & Review

1. What are the six classes of Arthropods? Name some animals in each class. What are the physical characteristics of each class, i.e. Arachnids have two body regions (head and thorax), no antennae and four pairs of legs.

## Fifth Meeting

1. Open the meeting with Roll Call by having members name an insect part, an insect relative (which class is it in?) etc.
2. Review or demonstrate how to pin the various orders of insects. You may want to begin or repeat the demonstration on how to spread the wings of a butterfly. Distribute insect pins and have members pin the insects they have collected.
3. Continue with Lesson 3 - How Insects Grow.
4. Distribute fact sheet and demonstrate How to Pin Insects and How to Preserve Immature Insects.

## Questions & Review

1. What is the term used to describe insect growth? 2. Explain the term "metamorphosis."
3. Name the stages of growth, and use the Growing-Up Word Search game for questions and review.

## **Sixth Meeting**

1. Open with Roll Call game.
2. Continue with Lesson 3 or start with Lesson 4 - How Insects are Classified.
3. Demonstrate how to use the insect label and how to adjust the height of the insect and the label on the insect pin (see fact sheet).
4. Distribute fact sheet - How to Make a Pinning Block.
5. Show how to arrange the insects in the display case. Show how the order labels should be placed on the display box (see fact sheet).
6. Demonstrate how to use the key to identify insects to order.

## **Questions & Review**

1. How are animals classified?
2. What are the seven major orders of insects?
3. What kind of mouthparts does a particular order have?
4. What are some physical characteristics of an order?

## **Seventh Meeting**

1. Open with Roll Call game. Use it as a review.
2. Continue with Lesson 4 or start Lesson 5 - Where to Collect Insects.
3. Do learning activities in lessons.

## **Other Suggested Ideas for 4-H Entomology Meetings**

Plan to use some of the following ideas during the year to make 4-H Entomology Club more interesting.

1. Show how to make special equipment that can be used in the entomology project.
2. Plan to have a talk on insects by an experienced person - such as a former member, local beekeeper, local insecticide dealer or fieldman, biology teacher, Extension Entomologist or County Extension Agent or insect collector. Close this discussion with comment on "Careers in Entomology."
3. Have a joint meeting with another 4-H Entomology Club, each having its own program.
4. Plan at least one meeting where parents are invited. Arrange the program to fit the interests of the parents - such as, fly control, forage insects, household insects or a film on entomology.
5. Have members bring insects to the meeting and tell where collected, what they were eating, whether beneficial or harmful.
6. Have two or three members select one insect, give its life history, interesting information about the insect, whether beneficial or harmful and type of destruction.
7. Have members bring examples of insect damage and tell about the insect causing such damage - examples are spruce gall aphids, columbine leaf miner, scales, borers, carpet beetles, infested stored grain and wireworm damage on potatoes.
8. Collect cartoons, verses or jokes about insects and show to members.
9. Have a scrapbook where members bring published articles about insects to their club.
10. Have an insect identification contest.
11. Have an exchange meeting where members trade insects with other members, visiting clubs or neighboring counties.
12. Take members on a field trip or collecting tour.
13. Visit an insect collection of an individual, a local university or state department of agriculture.
14. Visit an insecticide company laboratory if available.
15. Visit a garden supply dealer to observe different kinds of insecticides and equipment used for insect control.



Oregon 4-H Key to the Orders of Insects revised by Virginia Bourdeau, December 2015

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