AUTHOR

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CONTENTS

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Member's Manual 1: Basic Entomology

The following meeting topics are in the same order in which they appear in **Member's Manual 1: Basic Entomology,** (4-H 1335). Read the entire manual before covering these subjects.

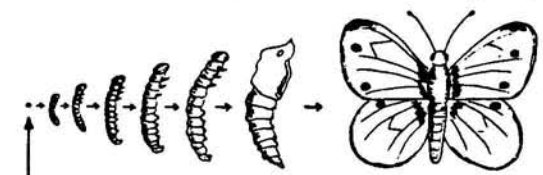
MEETING 1: WHAT IS AN INSECT?

(See Member's Manual 1, pages 2 to 7).

At the first meeting, you should "set the stage" for the entire project. It's important to create the right atmosphere and to share with the group some of the things they will be learning in the project.

Key Points

1. Young people are usually fascinated by insects and 4-H entomology is a way for them to learn more about insect types, behaviors, uses, harms, life cycles and habitats.
2. Insects are very important in our world and this is often overlooked. There are more insects in the world than all other animals combined; three-fourths of all animal species are insects.
3. It's important to be able to distinguish insects from similar animals, such as ticks, centipedes and spiders. Insects belong to the class INSECTA (or HEXAPODA), which means "six feet," as all insects have six legs or feet.
4. Insects vary in their growth patterns. Most insects change in form during development. This change is called **metamorphosis.** Each of the four types of metamorphosis is associated with one of the four immature stages of insects. Knowing the type of metamorphosis for each group (order) of insects is very important for successful pest control. It's generally true that during the insect life cycle, insects in the immature stage consume the most food.



Egg Larvae Pupa Adult

Activity Ideas

1. After the introduction to the project, have members list five reasons why they are interested in studying insects. Encourage them to share their lists. Ask each member to name five different insects. If possible, write the names they provide on a blackboard or on a large pad of paper with colored markers. After the list is recorded so that it can be easily viewed by all, go over it and distinguish between any insects and noninsects listed. Can they group their lists of insects into similar categories? Discuss the information in Member's Manual 1, "What Is an Insect?" on page 2.
2. Ask your 4-H'ers to identify characteristics that distinguish insects from all other arthropods. (Five characteristics are described in Member's Manual 1, page 3.)
3. Discuss how insects vary in growth patterns from other types of animals. Review the four types of metamorphosis (listed on page 11) from the most simple to the most advanced. Associate each type of metamorphosis with an immature stage, insect example and the order to which the insect belongs.
4. Use pictures from insect books or magazines to discuss the following:
   - What types of mouthparts, legs and wings can the members find?

- Why do some insects have chewing mouthparts and others have piercing or sucking mouthparts?
- Why do insects have such a wide variety of leg and wing types?

Type of Metamorphosis	Active Immature Stage	Example	Order
without metamorphosis	young	silverfish	Thysanura
gradual metamorphosis	nymph	grasshopper	Orthoptera
incomplete metamorphosis	naiad	dragonfly	Odonata
complete metamorphosis	larva	butterfly	Lepidoptera

MEETING 2: INSECT CLASSIFICATION

(See Member's Manual 1, page 8.)

Now that club members can identify what an insect is, the next step is learning to distinguish between different types of insects.

Key Points

1. Insects are classified or divided into groups based on various body or development characteristics. Classification starts with **orders,** which are the largest insect groups.
2. Classification is an aid to identification. The categories of scientific classification are **kingdom, phylum, class, order, family, genus** and **species.**
3. This page includes the more important orders of insects. The major orders are given in bold type because 90 percent of all insects are in these orders. Following each order name is the literal translation (the true meaning of the name) and then some common examples or the common name applied to the order as a whole. For example: Coleoptera—sheath wing (the word being derived from "coleos" meaning sheath and "ptera" meaning wing)—beetles (the common name for members of this order).

Activity Ideas

1. Have members give examples of orders and some of the insects in each order. (If you have older, experienced members in your club, they could show insect examples to new or younger members.)
2. Using portions of the list of orders, have members match the true meanings of the orders with common name examples and the order names. Cover a maximum of seven orders at a time so that members aren't overwhelmed with too much at once. (This could be done on paper in small groups or on a blackboard as a brainstorming activity for the entire group.)

Order Name	True Meaning	Common Name or Examples
Thysanura	bristle tail	silverfish, firebrats
Collembola	glue peg	springtails
Orthoptera*	straight wing	grasshoppers, crickets, katydids, roaches, mantids, walking sticks
Dermaptera	skin wing	earwigs
Ephemeroptera*	lasting but a day (short-lived wings)	mayflies
Odonata	toothed	dragonflies and damselflies
Plecoptera	pleated wing	stoneflies
Isoptera	equal wing	termites
Mallophaga*	wool eating	chewing lice
Anoplura*	unarmed tail	sucking lice
Psocoptera*	minute wing	book and bark lice
Thysanoptera	bristle wing	thrips
Hemiptera*	half wing	true bugs
Homoptera*	same wing	leafhoppers, cicadas, aphids, whiteflies, mealybugs and scale insects
Coleoptera*	sheath wings	beetles and weevils
Mecoptera	long wings	scorpionflies and hangflies
Neuroptera*	nerve wing	lacewings, ant lions, dobsonflies
Trichoptera	hair wing	caddisflies
Lepidoptera	scale wing	moths, skippers, butterflies
Hymenoptera	membrane wings	sawflies, ants, bees, wasps
Diptera	two wings	flies, gnats, midges, mosquitoes
Siphonaptera	tube without wings	fleas

*As you look through other entomology books, you may notice some difference in insect classification and order names. As an example, you may see cockroaches, walking sticks, and mantids placed in orders Blattodea, Phasmatodea, and Mantodea rather than in Orthoptera. This is just a difference of opinion among entomologists. See the list below for the orders that are inconsistent. The preferred names are given in bold type. These are preferred because they are the most commonly used and standardly accepted.

Variation in Order Names

Common name	Alternate name	Preferred name
Mayflies	Ephemerida	**Ephemeroptera**
Cockroaches	Blattodea	**Orthoptera**
Walking sticks	Phasmatodea	**Orthoptera**
Mantids	Mantodea	**Orthoptera**
Book lice	Corrodentia	**Psocoptera**
Aphids, hoppers	Heteroptera	**Homoptera**
True bugs	Heteroptera	**Hemiptera**
Sucking lice	Phthiraptera	**Anoplura**
Chewing lice	Phthiraptera	**Mallophaga**
Alderflies, dobsonflies	Maegaloptera	**Neuroptera**

3. Write several questions about 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 includes the largest number of insects?
   - How does Hemiptera differ from Homoptera?
   - Are a butterfly, caddisfly and house fly in the same order? Why? Name the order(s).

   For variation, write all the questions on a chalkboard or large piece of paper. Have the 4-H'ers roll a die. If a member rolls a 1, he or she will answer the first question, and so on. This will challenge all members to think of the answer to each question since they won't know which number they'll roll.
4. Provide several pictures of insects. Ask members to identify an insect based on the order characteristics you provide.

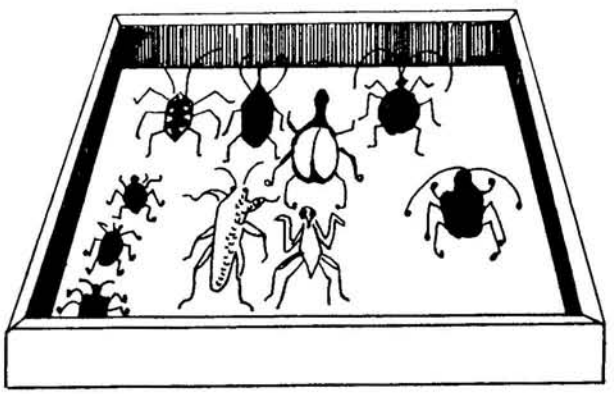
MEETING 3: MAKING AN INSECT COLLECTION

(See Member's Manual 1, pages 9 to 16.)

Making an insect collection helps 4-H'ers learn more about the many species that live around them. This section will help you get your club members started. Depending on the amount of time available and the size of your club, you may want to divide this section into two or more meetings.

Key Points

1. By studying live insects, 4-H'ers can learn about an insect's life stages and habits. However, they won't discover the vast number of species that live all around them until they start their own collections with well-preserved and labeled specimens. The best kind of insect collection for a 4-H'er to start with is one consisting of every kind of insect he or she can catch anywhere he or she happens to be.



2. To begin collecting, members need a minimal amount of equipment. Most equipment costs little and some of it can be quite suitably improvised. Essential equipment includes a net, killing jar, insect pins, scissors, spreading board, insect labels, temporary specimen boxes and a fine-pointed pen. Other equipment that's useful includes a pinning block and forceps or tweezers.
3. The key to making a large and varied collection of insects is to know something about insect food habits and where and how they live.
4. Whenever an insect is collected, members should record the date and place it was caught and who caught it. This will make the specimen a piece of scientific information.

Activity Ideas

1. To enable your members to become active collectors, you'll want to help them secure or make the necessary equipment. You might spend one meeting helping your entire club make nets, killing jars and spreading boards. Instructions for these are given in Member's Manual 1 on pages 13 to 16.
2. Plan a field trip to two or three different habitats. Have your group develop a list of places where they should look for insects in each habitat. Also have them give examples of the types of insects they are likely to find in each place.
3. Have 4-H'ers present information on the food habits and habitat of an insect that interests them. Have them explain why

knowing this information is helpful to an insect collector.

4. If applicable, have members present information on how they've successfully collected insects in the past. Have them show the insects they've already collected.
5. Ask members to demonstrate how to properly swing a net and how to use a killing jar.
6. Have your members discuss how they will keep track of where an insect was caught, when it was caught and who caught it. This scientific information adds to the value and accuracy of the collection and is later recorded on insect labels. The **4-H Entomology Record and Report,** (4-H 1393) could be used for this purpose.

MEETING 4: PRESERVING AND MOUNTING INSECTS

(See Member's Manual 1, pages 17 to 20.)

The next step after collecting is to preserve and mount the insects. Unless members will be storing their insects in the freezer, you should schedule this meeting a day or two after the insects have been collected to prevent them from drying out. You should also keep in mind that your club members will need a place to temporarily store their insects once they are mounted. (Meeting 5 covers how to make an insect display case.) Any box with a cover (such as a gift box or cigar box) is suitable for temporary storage. Place a sheet of Styrofoam on the bottom of the box to serve as the base to pin the mounted insects into.

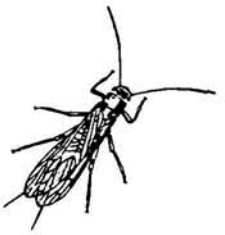
Mounting pins can usually be obtained from college bookstores, hobby shops and by mail order. For more information on supplies, get a copy of the **4-H Entomology Resource Guide** listed in the **Resources** section of this publication.

Key Points

1. If possible, insects should be mounted within one or two days after they are dead. Otherwise they may dry out and will need to be relaxed before being mounting.
2. If you must delay mounting insects, store them temporarily in a freezer to retain their suppleness. Hard-bodied insects can be stored temporarily in alcohol to retain suppleness. Dried insects can be relaxed by using a relaxing container or by soaking or steaming in water. (See page 19 of Member's Manual 1, for more information.)
3. Insects are pinned through the thorax (the middle section of the body). Some variation occurs among the many groups of insects as to where they should be pinned. (See page 17 of Member's Manual 1 for further pinning information.)
4. Spreading Lepidoptera is a more complicated task to learn but can be mastered with practice and patience! (See Member's Manual 1, pages 18 and 19, for more information.)
5. Specimens too small to be pinned should be mounted on triangular paper points. Some soft-bodied insects should not be pinned at all but should be preserved in small vials of alcohol. (More information on these topics is found on pages 19 and 20 of Member's Manual 1.)

Activity Ideas

1. Allow some insect specimens to dry out so that 4-H'ers can compare mounting dried insects with mounting freshly killed insects. Ask each member to collect a few insects before coming to the meeting. Then have each 4-H'er mount a few dried and fresh insects and discuss the difference among them.
2. Have an unpinned grasshopper, beetle and true bug on hand. Ask the members to show where each is pinned and name the part of each body where the pin goes. (Refer to Member's Manual 1, page 17.)
3. Have a member who has perfected a specific mounting technique (such as spreading Lepidoptera or pinning with paper points) demonstrate that technique to the rest of the club.



MEETING 5: LABELING, STORING AND DISPLAYING COLLECTIONS

(See Member's Manual 1, pages 21 and 22.)

Although this is certainly not the most glamorous part of making an insect collection, it's definitely one of the most important! Having insects accurately labeled and neatly displayed increases the aesthetic and scientific values of a collection. Properly storing a collection can make it a valuable keepsake for years to come.

Key Points

1. Insects should be labeled with the following information: location, date of collection, name of collector and name of insect. Printed labels (**4-H Entomology Labels, 4-H 1231**) are furnished for 4-H entomology projects. Request them from your county 4-H staff. If you're working with younger 4-H'ers, you may want to simplify the labels and make them larger to accommodate the members' style of printing.
2. Insect collections must be properly stored to protect them from dust, damage and pests. The best way to prevent the entry of live insects that feed on a collection is to use **napthalene mothballs.** Other kinds of mothballs may melt the Styrofoam pinning base. See Manual 1, pages 21 and 22, for more information on how mothballs should be used.
3. Pinned and labeled specimens should be neatly displayed in collection boxes. A standard, wood museum display case with a glass top is strongly recommended. For short term use, however, cigar, shoe, shirt or pizza boxes can be suitable substitutes.

Activity Ideas

1. Have 4-H members practice labeling insects properly. Encourage them to share tips for producing attractive labels. It's better to have members make their own labels than for parents or other adults to do it for them. Making their labels helps 4-H'ers develop the life skills discussed on page 2!
2. Following the instructions on page 22 of Member's Manual 1, help 4-H members construct their own collecting boxes. **Special notes regarding box making:** The box grooves should be cut at 3/16 of an inch so that the 1/8-inch glass has slack for sliding. The bottom of the box should be covered with Styrofoam, not cellutex, to allow easy pinning.
3. Prepare (in advance) some labeled insect specimens and a practice collection box. Specimens should be grouped together in rows or clusters by order. It doesn't matter which order is displayed first. Have members practice arranging these insect specimens to see what looks best. Have them practice as though they were preparing for the fair.
4. Discuss ways that collections might be damaged (such as by mold, dust, dermestid beetles, cats, mice, ants and younger siblings) and what members can do to protect their collections.

MEETING 6: IDENTIFYING INSECTS

(See Member's Manual 1, pages 23 to 27.)

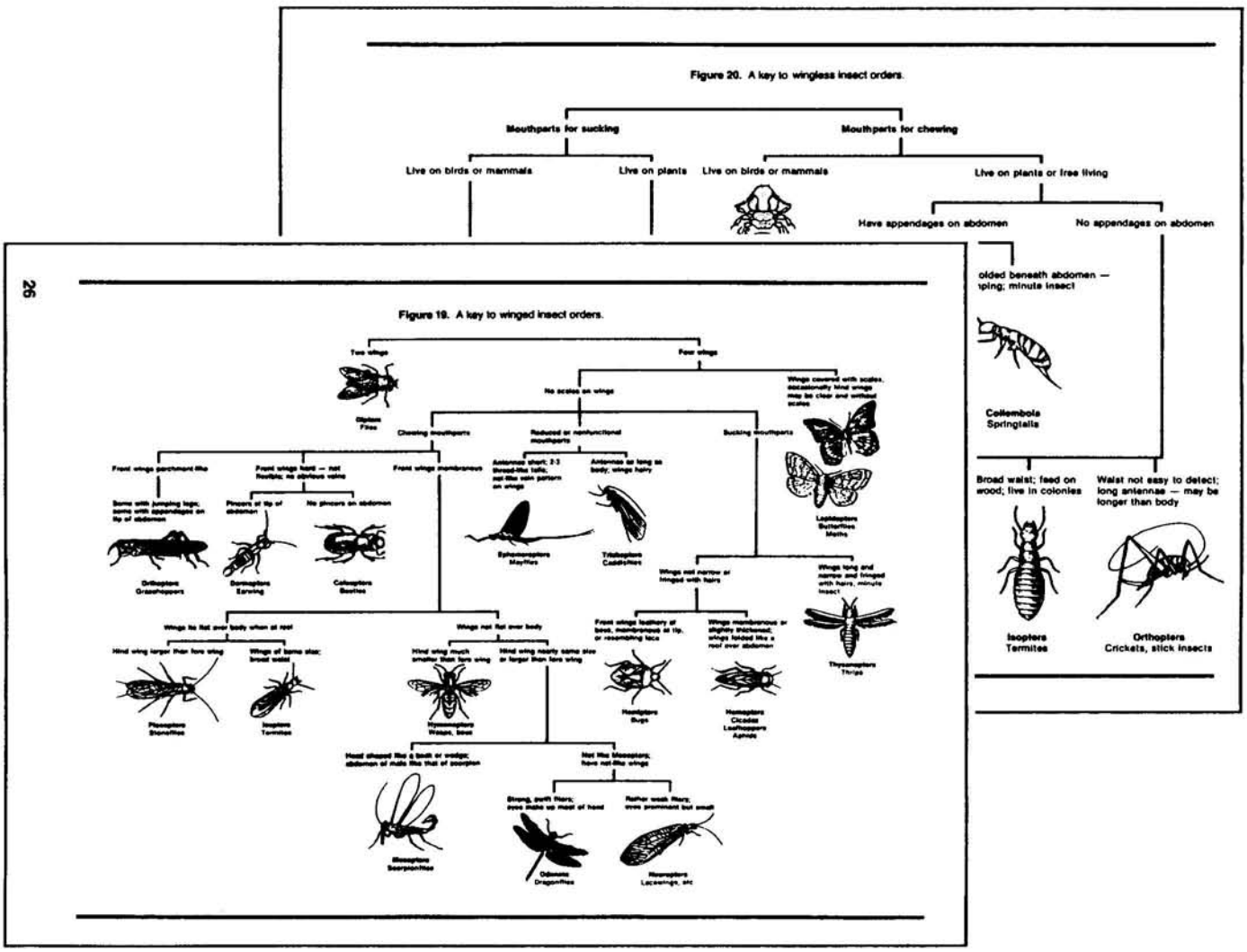
Identifying insects can be a fun and challenging experience. A wealth of resources are available for use by you and your 4-H members.

Key Points

1. A classifying tool called a **key** can be used to sort out common features and determine correct identification. Depending on what resource you use, an insect may be identified by order, family name or common name.
2. There are many useful reference books which can help 4-H'ers determine insect common names and enhance learning about insects. For a list of recommended references refer to "Determining the Common Name" in Member's Manual 1 on pages 23 to 25.

Activity Ideas

1. Ask members to bring insects that they need help identifying. In small groups, have them identify these insects using the identification key in Member's Manual 1 on pages 26 and 27. Have them further identify each insect by using reference books. Afterward, have them discuss how easy or difficult it was to use the key.
2. Have 4-H members, either individually or in small groups, construct a model of a grasshopper which clearly shows the different body parts. They could use materials such as clay, wood, paper or pipe cleaners. Have them trace the identification of their model using a key.
3. Go back to the insect classification list on page 11 of this guide and have members give examples of orders and some of the insects in each order.



Member's Manual 2: Advanced Entomological Techniques

The following meeting topics have been listed in the order in which they appear in **Member's Manual 2: Advanced Entomological Techniques,** (4-H 1336). These topics do not necessarily build on each other and can be covered in any order suitable to your club's needs. Read the entire manual before covering these subjects.

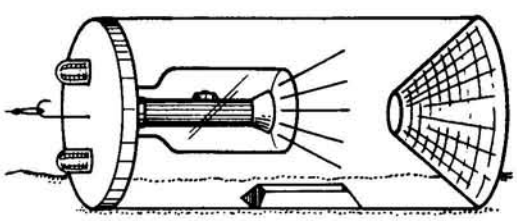
MEETING 7: ADVANCED COLLECTING TECHNIQUES

(See Member's Manual 2, pages 2 to 12.)

Once your members have mastered the basic collecting techniques covered in Manual 1, they will be eager to learn techniques that will help them collect a greater diversity of insects!

Key Points

1. Water dwelling insects **(aquatic)** can be collected by techniques such as dip netting, treading, emergence trapping and aquatic light trapping.
2. **Terrestrial** insects are ground dwelling insects, many of which are active only at night. They can be collected by using equipment such as a pitfall trap, pan trap, emergency trap, Berlese funnel, aspirator, headlamp or flashlight and by using techniques such as sifting, flotation and baiting.
3. The collection of **aerial** (flying) insects is not restricted to the use of nets. A large number of insects can be captured with windowpane traps, malaise traps, bait traps and light traps.



Aquatic light trap.

4. **Plant associated** and **arboreal** insects may reside on or within a plant (in the wood, stems, twigs, leaves and fruit). To collect these insects, use beating sheets and trays, aspirators, separator boxes and emergence traps.
5. **Animal associated** or **ectoparasitic** insects live on the exterior of an animal. Extraction and animal nest collection techniques can be used to collect these types of insects.

Activity Ideas

1. Have members give examples of insects from each of the five habitat types listed above.
2. Help your 4-H'ers make collecting equipment such as a dip net and pitfall, bait and emergence traps.
3. Ask members to demonstrate one or more of the collecting techniques to the rest of the club.
4. Plan a field trip so that your members can use different collecting techniques. Have them examine and discuss the diversity of the insects they collect. Example discussion questions are: Did you collect different types of insects than what you've collected before? Which techniques were the most successful for you and why?

MEETING 8: ADVANCED SPECIMEN PRESERVATION

(See Member's Manual 2, pages 13 to 15.)

The use of proper preservation techniques will ensure that your club's collection efforts are not wasted and that their specimens will last for many years.

Key Points

1. Hard-bodied insects are usually preserved by dry mounting, while soft-bodied insects are preserved in liquid.
2. Most insect specimens can be temporarily stored in a refrigerator for up to a week (with parental approval!). Specimens can be indefinitely preserved if placed in the freezer instead of the refrigerator. Storage containers must be airtight for proper storage and preservation.
3. Many hard-bodied (adult) insects can be temporarily stored in a liquid preservative, such as alcohol, with satisfactory results. (See Member's Manual 2, page 15, for more details.)
4. Hard-bodied insects can also be indefinitely stored in paper triangles, glassine envelopes or in layers in small boxes. They'll need to be relaxed before mounting.
5. Dried specimens can be relaxed by using a relaxing chamber or by steaming. Many hard-bodied insects, except those covered with scales or hair, can be relaxed by placing them directly in very hot water. (See page 14 of Member's Manual 2 for directions.)

Activity Ideas

1. At a club meeting try each of the different preservation methods described in Member's Manual 2 on pages 13 to 15. (In addition to having members make a relaxing chamber, you should prepare one in advance to show your 4-H'ers examples of relaxed specimens.) Then have them share what they liked and disliked about each method.
2. Have experienced club members demonstrate relaxing, cleaning and repairing techniques to new or less experienced club members. Have all members practice each of the techniques.

MEETING 9: STORAGE AND CARE OF COLLECTIONS AND SPECIALTY COLLECTIONS

(See Member's Manual 2, page 16.)

Proper storage and care of a collection can make it last a hundred years or more! Encourage your members to make a specialty collection so they can share it with others in years to come.

Key Points

1. Collections should be kept in a dark, cool location and protected from pests and fungi by using a fumigant and by avoiding moist, humid conditions.
2. Specialty collections can be made to study and display a single, specific order or family of insects. Another alternative is to display insects with common characteristics such as beneficial insects, immature insects or aquatic insects.

Activity Ideas

1. Help members be sure they are properly storing and caring for their collections by protecting the collections from jarring, vibration, dust, light, pests and dampness.
2. Encourage interested members to begin specialty collections. These collections could be made up of aquatic insects, camoflage insects or insects that mimic other insects (such as viceroy and monarch butterflies). See Member's Manual 2, page 16, for additional ideas. Have your 4-H'ers display their specialty collections and discuss the common characteristics of these insects with the club or with other interested groups. You may wish to check whether specialty collections can be exhibited at your county fair.

MEETING 10: THE ENTOMOLOGICAL COMMUNITY

(See Member's Manual 2, pages 17 to 18.)

Many opportunities exist for 4-H'ers to network and develop friendships with other people interested in entomology. They may even become friends with someone from another country and expand their global awareness.

Key Points

1. Many clubs and organizations exist for youths, amateurs and professionals interested in entomology. More information can be obtained from the 4-H entomology Extension specialist at the Department of Entomology at Michigan State University.
2. Insects can be "collected" from other states, regions or countries through exchanging or trading with someone collecting in the desired area. Insects should be properly packed for shipment.

Activity Ideas

1. Encourage members to explore groups such as the Young Entomologists' Society (YES).
2. Invite a Michigan Entomological Society (MES) member to speak to your club about the field of entomology and his or her particular job or specialty.
3. Have members collect extra insects and trade them with collectors in other states or countries. Encourage them to compare the differences and similarities between insects collected locally and those collected elsewhere.
4. If your members are bothered by teasing or ridicule from their peers because of their interest in insects, help them explore ways to deal with it. Older 4-H'ers may want to become involved with 4-H Peer Plus projects.

Member's Manual 3: Insect Life Cycle Studies

The following meeting topics have been listed based on the order in which they appear in **Member's Manual 3: Insect Life,** (4-H 1406). These topics do not necessarily build on each other and can be covered in any order suitable to your club's needs. Read the entire manual before covering these subjects.

MEETING 11: REARING INSECTS

(See Member's Manual 3, pages 2 to 23.)

By rearing insects, 4-H members can learn important lessons about insect life cycles. Rearing insects also helps them develop responsibility and increases their ability to follow directions.

Key Points

1. By studying live insects, your members learn how insects feed, grow, behave, disperse and reproduce.
2. Club members could make money by raising and selling insects. Possibilities include beekeeping and raising insects for fish bait, pet food and biological supply companies.
3. Live insect cultures can be obtained by purchasing insects from biological supply companies or by collecting them. By gathering their own specimens, 4-H'ers will better understand the habitat and natural conditions of the species they are raising.
4. Details about collecting, rearing, feeding and watering live insects can be found in Member's Manual 3, on pages 6 and 7.
5. Insects that can be easily reared include aquatic insects, house and field crickets, **Blaberus** cockroaches, milkweed bugs, mealworms, flour beetles, wax moth larvae, butterflies, moths and ants. Details on how to obtain each of these types of insects and care for them based on their habitat requirements are given in Member's Manual 3 on pages 8 to 19. Manual 3 also includes information on rearing spiders and other arthropods on pages 20 to 22.
6. Insects can be reared as either long-term or short-term projects.

Activity Ideas

1. Have members (either individually or in small groups) design posters which show either the incomplete or complete metamorphosis of an insect. Use drawings, photographs or actual specimens to illustrate the metamorphosis.
2. Interested members could research raising and selling insects for profit. They could then report their findings to the rest of the club.
3. Conduct a field trip for 4-H'ers to collect live specimens followed by a meeting for them to set up the proper type of habitat for rearing their insects.
4. Search for cocoons in the fall or winter. Use artificial conditions to speed each insect's metamorphosis to the next phase.
5. Members that are rearing insects as long-term or short-term projects (or perhaps doing both) can compare their projects and discuss what they've learned as well as the advantages and disadvantages of long term and short term projects.
6. If several members of your club are rearing live insects, arrange to display your club's insect zoo at a fair, school or other event.

MEETING 12: FIELD OBSERVATIONS OF LIVE INSECTS

(See Member's Manual 3, pages 24 and 25.)

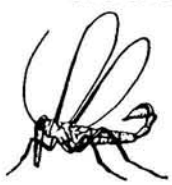
Field observations of live insects can be extremely interesting. They may also provide insight into some of the many unanswered questions your members have about insects.

Key Points

1. Many interesting facts about insect life cycles, behavior and ecology can be discovered by observing insects in their natural habitat.
2. When making field observations, each observer should record his or her observations in a notebook.
3. Some observations are best recorded as photographs. Sound recordings may also be used to gather information on insects which "sing" or make other sounds.
4. Always record the: date, location, habitat conditions, observations and names of the observers.
5. Field observations can be done on insect development and life cycles, insect behavior, and insect populations and communities.

Activity Ideas

1. Record the sounds made by different insects. Share the recordings with the club and see if the members can identify each insect by its sound.
2. Watch insect and plant interaction. Choose a plant that attracts a number of insects (such as goldenrod, spirea, milkweed and wild carrot) and record the activity and number of insects that you find on an individual plant or in a patch of the plants. Be sure to check the foliage, flowers and woody portions of the plant.
3. Make a display showing the process bees use to make honey or the way a bee manipulates a flower to pollinate it.
4. Make a portable sand box for ant lion larvae and show others how the larvae trap ants.



MEETING 13: EXPERIMENTS WITH LIVE INSECTS

(See Member's Manual 3, pages 28 to 34.)

Conducting experiments with live insects is an excellent way for 4-H members to learn and practice the scientific method, learn more about entomology and develop life skills.

Key Points

1. Many interesting facts can be discovered about insect life cycles, behavior and ecology by experimenting with live insects under carefully regulated artificial conditions.
2. Through conducting entomology experiments, 4-H'ers can learn and practice the scientific method. The purpose of the scientific method is to distinguish facts (things which can be proven) from beliefs (things which are only ideas or opinions and may or may not be true).
3. After conducting an experiment, 4-H'ers should prepare a report to share with others. You might suggest they give an oral report to the club and submit a written report to the **YES Quarterly.** (See the **Resources** section of this guide for more information.)
4. Members can do illustrations to complement their reports, heighten their awareness of detail and improve their observation skills.

Activity Ideas

1. Create activities that relate to the key points above. Examples of experiments are given in Member's Manual 3 on page 34. Choose an experiment from the manual and have members discuss possible outcomes of the experiment and how the different outcomes could be interpreted.