

4-H ENTOMOLOGY LEADER'S GUIDE



AUTHOR

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Welcome to 4-H Entomology



Welcome to the 4-H entomology project area. Entomology (en-toe-mol-o-gee) is from the Greek word **entomo**, meaning insect. Entomology is the science dealing with the study of insects. It will introduce you and your 4-H members to many new and exciting experiences. As well as being fun, it will help you and your club learn about the important and fascinating world of insects. You may even help a 4-H member prepare for a career in entomology. You can help your 4-H'ers to understand the role of insects in world ecology and economy and to discover the different careers related to this field.

How to Use This Manual

This manual offers many ideas to help you as a 4-H entomology leader. These include suggestions for group lessons, extra information on techniques, possibilities for field trips and demonstrations and a list of resources. This guide is designed to help you:

- Understand your role and responsibility as a 4-H leader.
- Develop competency in subject matter knowledge and teaching techniques.
- Know what resources are available to help you.
- Know how to guide youth in project selection, design, development and implementation.
- Involve other adults as potential leaders.
- Learn answers to questions leaders frequently ask.
- Understand beginning and advanced 4-H member skill levels.

The 4-H Entomology Leader's Guide is also designed to help you teach the key concepts covered in the 4-H Entomology Member's Manuals. The chapters of this leader's guide correlate with the topics covered in the following Member's Manuals:

- **Manual 1: Basic Entomology** (4-H 1335)
- **Manual 2: Advanced Entomological Techniques** (4-H 1336)
- **Manual 3: Insect Life Cycle Studies** (4-H 1406)

Before your first club meeting you should become familiar with the 4-H Entomology Leader's Guide and all three Member's Manuals.

4-H Entomology Project Objectives (Core Curriculum)

Like all 4-H projects, the 4-H insect project is designed to help members become self-directing, contributing and productive members of society. While learning about different aspects of the project, young people will also acquire many life skills:

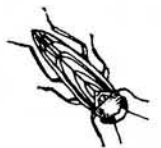
- They develop their **communication** and **organizational** skills by giving demonstrations and speeches, and by learning to exchange ideas.
- They explore **decision-making** and **problem-solving** by learning that alternative solutions to problems do exist.
- They discover how to **cope with change** by evaluating new concepts and thinking about how these concepts can affect them individually and as part of a group and the larger community.
- During all of this, members gain a sense of accomplishment and control, both of which increase their **self-esteem**.

This seemingly “hidden 4-H agenda” ensures that 4-H’ers in an insect project become well-rounded in life skills and their knowledge of insects.

WHAT WILL MEMBERS DO?

By taking part in a 4-H insect project, members will:

- Discover why insects are important in the world. They will learn about beneficial and harmful insects, and the roles these “bugs” play.
- Develop, and help others develop, a healthy, realistic attitude toward insects (such as discovering that not all insects are bad).
- Recognize the distinguishing characteristics of insects.
- Learn the parts of different types of insects.
- Learn about the growth patterns and developmental stages of insects.
- Learn how to identify and classify insects into orders, families, genera and species.
- Learn about different kinds of collecting methods and equipment.
- Learn different ways to preserve, label, store and display insects.
- Explore different types of insect collections.
- Discover what is involved in rearing different kinds of live insects.
- Learn how to develop and conduct a scientific experiment.
- Learn about existing entomology clubs and organizations.
- Explore the role of pesticides in agriculture, horticulture and home environment, and learn about principles of integrated pest management.
- Learn about the many types of careers related to entomology and the role of amateurs in entomology.
- Integrate their insect project with other project areas such as photography, environmental education, crop and soil sciences, FOLKPATTERNS and animal projects (such as livestock or dog projects).
- Explore many life skills including health and safety, leadership, self-evaluation and reference skills (knowing how to consult other sources of information), as well as those “hidden” skills listed previously.



Role of the Leader

As a 4-H insect project leader you should have an interest in both insects and young people. Your goal should be to help your 4-H'ers fulfill as many of the objectives listed on page 2 as possible. The satisfaction of seeing members increase their knowledge of insects and benefits from the other components of a well-rounded project will be immeasurable!

As the 4-H leader you are the key person in your club. The success or failure of your entomology program depends a great deal on your interest and initiative, but the whole load should not rest on your shoulders. Your job is to help your club members plan and carry out a program based on their needs, interests and abilities. That's a big job, of course!

One of the first things to realize is that you don't have to be an entomology expert to be a good 4-H entomology leader. If you're able

to create learning opportunities and find information and answers when needed, then you're all set. You'll learn the rest right along with your 4-H members!

There are many sources of help in connection with your entomology program. Your county Cooperative Extension Service staff can provide you with publications, training aids and other assistance as needed. They have access to all the resources of Michigan State University and the United States Department of Agriculture. For additional sources, refer to the **Resources** section near the end of this guide.

Your role as an entomology leader will vary depending on the age and experience level of your 4-H'ers. Your greatest asset is your own ingenuity. You are not expected to know everything, and help is available.

LEADER OPPORTUNITIES

There are other opportunities for you to consider as a 4-H leader. Each year there are workshops for leaders in your county or region where you can learn from experts and share ideas and experiences with other leaders. Through these workshops you can improve your knowledge of insects and also learn ways to enhance your leadership skills. The 4-H program focuses on expanding the life skills of leaders as well as members. Check with your county Cooperative Extension Service office for dates and locations.

Another opportunity available is serving on the State 4-H Natural Resources and Environmental Education Developmental Committee. This committee sets the focus and goals of the entomology project for the whole state. For more information on how you can get involved, contact your county Extension staff.



Working With Youth

WHAT DO THEY WANT TO LEARN? WHAT DO YOU WANT TO TEACH?

Many times people think of 4-H entomology as only the collecting of insects for fair exhibition. It is in fact much broader than that! There are numerous opportunities for young people to learn things about entomological science other than collecting, and to develop other entomological skills. (See **Appendix A** for suggested fairbook guidelines to get an idea of what other opportunities might be available for fair exhibiting.)

Another thing to keep in mind is that not all the activities or learning experiences you do with your 4-H'ers need to lead to a fair project. As 4-H leader you are encouraged to get your members involved in fun and valuable learning experiences that may not turn into projects for the fair. For instance, an observation study of live insects in their natural environment can

be a fun and valuable learning experience for your club members. (More information on conducting observation studies can be found in **Member's Manual 3: Insect Life Cycle Studies**, 4-H 1406.)

When working with 4-H'ers you are encouraged to:

- Offer experiences to each child according to his or her needs, interests, abilities and goals.
- Help young people build creativity, confidence and positive values.
- Appreciate the natural expression of each child.
- Refrain from imposing adult standards on children and their entomology projects.
- Provide recognition for project or personal development.

SPECIAL NEEDS AND CONSIDERATIONS

One of the first things you'll want to consider is the age, experience level and size of your group. Keep in mind that attention span, comprehension level and hand-eye coordination is going to vary greatly between children of different age groups.

Working with 5- to 8-year-olds

Kids in the 5- to 8-year-old age group have a natural curiosity about everything. For this reason they are at an ideal stage for learning about the insect world!

You should have a variety of action experiences planned for your 5- to 8-year-old 4-H members. Don't expect to hold their attention for longer than 10 minutes at a time while providing instruction or other information. Experts advise that there be one adult or teen helper for every six children.

Some activities you may wish to do when working with this age group include:

- Creating insect models using materials like pipe cleaners and bottlecaps.
- Making insect puppets.
- Putting together a scrapbook about insects. (You may want to use themes such as what do they look like or where do they live.)
- Learning about butterfly gardens and plants.
- Exploring insect terraria and zoos.
- Taking a field trip to look and listen for insects.
- Identifying recorded insect sounds and songs.
- Doing block printing (an older youth or adult would need to do the carving).
- Making stencils (insect cut-outs).
- Making jigsaw puzzles (cut up a picture of an insect and put it back together).
- Learning songs, plays, skits or stories made up about insects.
- Playing board games, card games or insect bingo.

4-H Kaleidoscope: Just Outside the Door materials are available for working with 5- to 8-year-olds in entomology. Contact your county Cooperative Extension Service staff for more information.

Working with pre- and early adolescents

Children in this age group desire independence, yet they want and need direction from adults. To provide balance between these two opposing needs, a 4-H leader can encourage members to get assistance from teen leaders, other adult leaders, parents and peers. Another characteristic of this age group is a desire for group activity, so you might have members work in small groups. With the younger members of this age group (9- to 12-year-olds) you may find it best to separate boys and girls for project work, since 9- to 12-year-olds tend to prefer being with members of their own sex.

4-H leaders working with pre- and early adolescents should also try to outline directions in detail. Make record-keeping as simple as possible and ask for short narrative reports that will prompt members to review what they have learned.

Working with older or experienced members

Aside from a standard insect collection, most entomology projects are self-determined and allow 4-H'ers to select, plan, develop, carry out and evaluate a project of their own choosing. Older teenagers want and need the opportunity to do things for themselves. At the same time, they want and need ideas, suggestions and friendly, caring involvement from adults. Under your guidance, teens will decide on a goal they want to attain. They'll decide on activities to help them meet their goals and will carry out those activities. Members will keep records of their progress and evaluate their project when it's finished.

By participating in self-determined projects, 4-H'ers learn important skills that they'll use throughout their lives. (Life can easily be viewed as a self-determined project!) Through planning and carrying out a self-determined project, 4-H'ers will learn many important skills, such as:

- Setting clear and achievable goals.
- Making choices and decisions among available options.
- Planning how to meet established goals.
- Using community resources.
- Setting realistic timetables.
- Assuming responsibility for their own learning.
- Evaluating their progress toward meeting their goals.

Remember, these skills are what 4-H is all about, regardless of the 4-H project!

Whether you're working with individual 4-H'ers or with groups, you'll need to schedule planning meetings to get older 4-H'ers started on their projects. The suggested meeting activities listed throughout this guide should help you come up with project ideas for older or more experienced 4-H entomology members.

Once the 4-H'ers have decided what they want to do for their specific projects, you'll be "on the sidelines" as a coach. You can offer the members occasional advice, direction, support and encouragement as teens test their abilities to plan and carry out their projects.

Working with new members

Be sure to keep in mind the characteristics of their age group when bringing new members into a 4-H club. After initial introductions you may want to plan a group activity to get the new member into the mainstream of the club. You also might consider asking one of the other members to serve as a "buddy" for a new member until everyone is comfortable and familiar with each other.



Teaching Techniques

Following are some helpful teaching techniques to use in your 4-H Entomology club.

DEMONSTRATIONS AND SPEAKERS

Demonstrations by members and speeches by guest speakers are very effective teaching techniques for the entomology area. Encourage your members to give at least one demonstration during the year to their club members or to other groups. These can be simple, informal demonstrations which will get the group members more actively involved in learning. You can also invite parents and other resource people to demonstrate or speak about specific topics.

Topics for demonstrations or speeches can include insect habitats, collecting techniques, preserving and mounting, insect identification, insect rearing, beekeeping and careers in entomology. Other topics are included in the activity suggestions for the different meetings. The list of possibilities is endless!

FIELD TRIPS

A field trip is an excellent club activity. It's a good way to provide 4-H'ers with necessary hands-on experience and to expand their knowledge and interest in entomology. A trip requires some planning, and you may want to discuss possibilities with the group at one of the first meetings. This will allow time for planning and making arrangements. At the meeting prior to the field trip, ask your members what they would most like to do, see or learn. You can then assist your 4-H'ers in planning the activities so that the interests they mentioned are included.

Following are some ideas for field trips:

- Take a collecting trip in your backyard or neighborhood to see what types of insects live there.
- Take a collecting trip to a few different types of habitats or explore insect habitats during different seasons or at night. (Later compare how the insects of each habitat or season were different and similar.)
- Take a cocoon collecting trip in the winter and watch the cocoons hatch in the spring.

- Take a trip to a university, science museum or insect zoo with a large insect collection. Arrange to have the group take a look "behind the scenes" so they can see how the museum maintains and expands its collection.
- Visit a university entomology department for a firsthand view of current entomological concerns and research. Explore possible career opportunities in entomology.
- Tour a beekeeping farm and see how honey is made.
- Visit a pesticide research center or a pest control company and explore how insect pests can be controlled.

If you are taking your club collecting, here are a few things that you should have for a successful trip.

- Collecting jars—at least one killing jar and two containers for live stock.
- A net (if you have one; it's not absolutely necessary).
- Mosquito repellent.
- A container of drinking water.
- First-aid kit containing at least a couple of adhesive bandages.

- Food (a snack for midafternoon, or lunch if you will be out during the noon or evening meal).
 - A pack or cloth bag with shoulder or belt straps to carry equipment.
 - Proper clothing, such as a hat to shade your eyes, comfortable shoes, old clothes (slacks or jeans to protect you from berry bushes) and a jacket or raincoat, depending on the weather.
 - Paper or plastic bags for collecting host plant specimens.
- When you go collecting, make sure you

know where you are going and how to get back before you leave the starting point. Anyone, even someone experienced in navigating in the wilderness, can get lost. The trick is to find your way before you hike an extra hour or two. So look at a map and carry a compass, especially if you are going into hilly or wooded areas.

Also, know what the dangers are, such as poison ivy, snakes and poisonous spiders. If there are any in the area, learn how to recognize and avoid them, and know what to do if you encounter them.

CAREERS AND HOBBY EXPLORATION

There are many careers in the entomology field and even more ways to be involved as an amateur. Thousands of people have exciting, creative jobs that involve collecting, identifying, rearing, controlling and researching insects. As part of your group's experience, encourage members to research some of the careers. Take your club on a field trip to a museum, university or other facility. Your members could plan to ask questions about careers and the types of training needed for those careers.

Older 4-H'ers interested in entomology careers should contact their county Extension office to explore possible summer jobs or internships with either the county or Michigan State University.

For sources of information on entomology careers, have your members check the local library. You could also contact the 4-H entomology Extension specialist. A free career brochure can be requested from the Entomological Society of America (ESA). Refer to the **Resources** section of this guide for the ESA address.

Members who do not want to be professional entomologists can be actively involved as amateurs. They can join the Young Entomologists' Society (YES) or the Michigan Entomological Society (MES). (Refer to the **Resources** section of this guide for the addresses of these organizations.) Entomology can be a lifetime hobby that provides fun while traveling, activities for the entire family,

decorations for the home, topics for conversation and much more! Knowledge of insects can help you in making pest management decisions in your home, work place and on public policy issues. You may also be able to contribute to science.

Another way to gather career and hobby information is to ask someone active in entomology to speak at one of your meetings. To begin finding people from your area, contact your county Extension agriculture agent, the Michigan Entomological Society, the Young Entomologists' Society or look in the yellow pages under pest control services. Your members could prepare questions for the guest speaker before the meeting.



Planning and Conducting Your Club Program

There are a number of things to consider when making choices and plans about how to conduct your club program. For each club meeting and activity you should consider where it will be held, how much time it will take (including preparation, activity and clean-up time), what materials are needed and how they will be provided. You may also need to consider which season of the year is most appropriate for each activity.

This leader's guide provides a number of club meeting activities that relate to the concepts covered in the 4-H entomology member's manuals. These activities are discussed

in the order they appear in the member's manuals. However, they do not necessarily need to be done in that order. Additional activity suggestions not related to any particular sections of the member's manuals are listed in this guide under **Innovative Projects and Activities** (see page 21). You may wish to consult these ideas occasionally to plan them in between, along with, or instead of other meeting activities. Also, don't forget to ask the 4-H members and their parents for input. They'll have a wealth of ideas!

MEETINGS

Holding your meetings in a home—yours or a member's—is probably the most convenient for you. Space may be a factor to keep in mind depending on the type of meeting activity. A school, church or community center may also

make its facilities available. Or, if you're having a collecting trip, you may wish to simply gather in an open field or a local park! You should do this planning in advance.

TEEN LEADERS AS A RESOURCE

One excellent resource you shouldn't overlook is the older, more experienced club members! By actively involving teen leaders in your 4-H club you can satisfy their desire for adult leadership opportunities and provide assistance for yourself in working with the rest of the club. Teen leaders can serve as good role models for younger 4-H'ers.

To help your teen leaders to be effective, they should be 3 to 4 years older and consistently more mature than the 4-H members with whom they are working. (Otherwise their leadership could be rejected by the other members.)

APPROVAL OF PROJECT PLANS

One of the advantages of 4-H is that the 4-H leader and club have the flexibility to choose their own activities to best meet the needs of the group members. However, as you work

with your 4-H club, be sure that your materials and activities relate to the 4-H entomology project curriculum listed at the beginning of this guide.

PARENTAL INVOLVEMENT

Don't forget that parents are an important part of the 4-H family! Be sure to invite them to meetings and seek their involvement and support of club activities. Parents can also

help their children maintain accurate and up-to-date records. A useful aid for record-keeping is the **4-H Entomology Record and Report** (4-H 1393).



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.

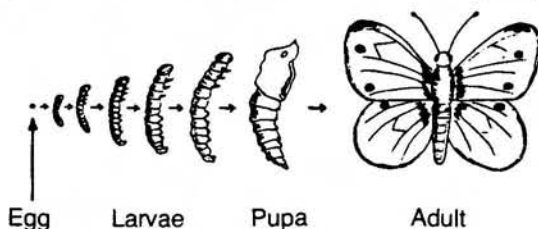
MEETING 1: WHAT IS AN INSECT?

(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.

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	Ephemera	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	Megaloptera	Neuroptera

- 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.

- Provide several pictures of insects. Ask members to identify an insect based on the order characteristics you provide.

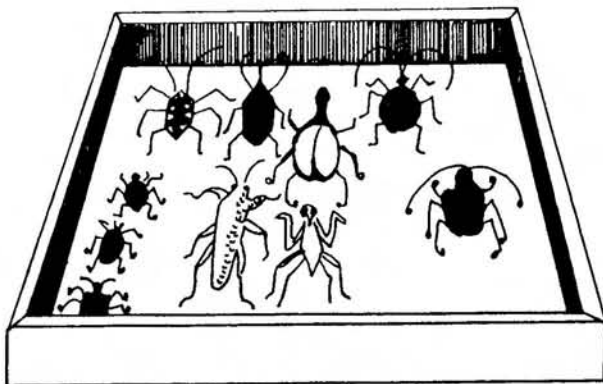
MEETING 3: MAKING AN INSECT COLLECTION

(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

- 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.



- 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.
- 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.
- 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

- 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.
- 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.
- 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

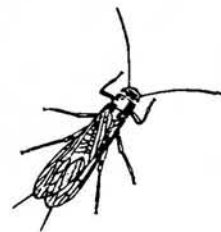
1. If possible, insects should be mounted within one or two days after they are dead. Otherwise they may dry out and will need to be relaxed before being mounted.
2. If you must delay mounting insects, store them temporarily in a freezer to retain their suppleness. Hard-bodied insects can be stored temporarily 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 **naphthalene 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 cellulose, 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

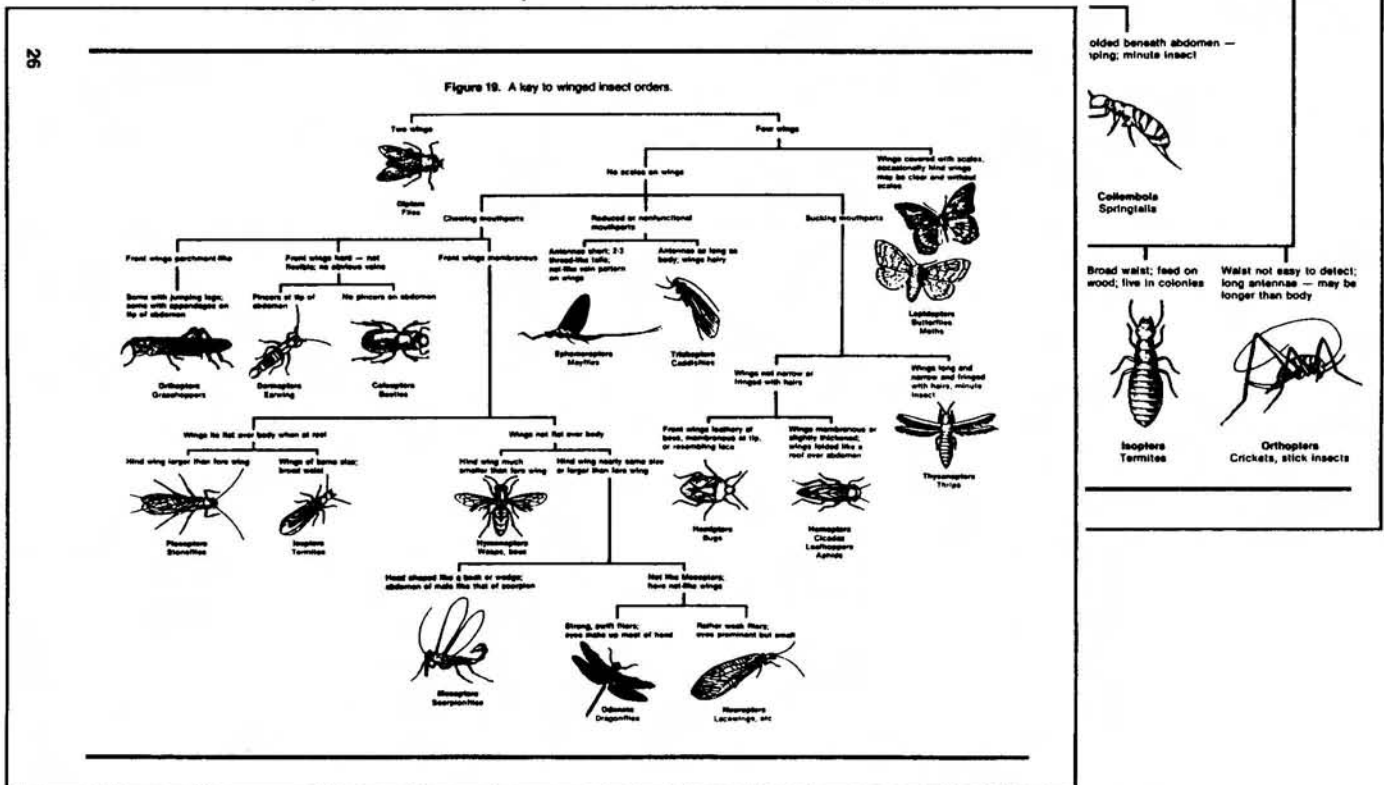
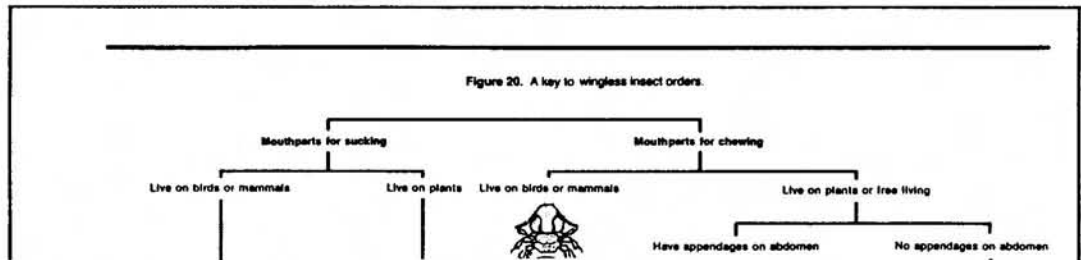
1. A classifying tool called a **key** can be used to sort out common features and determine correct identification. Depending on what

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.

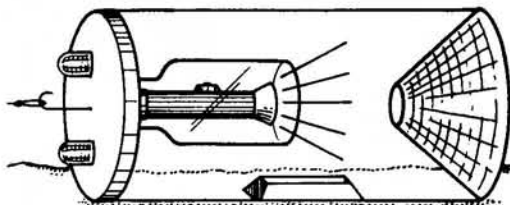
MEETING 7: ADVANCED COLLECTING TECHNIQUES

(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 window-pane 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, camouflage 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.)

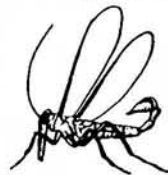
Field observations of live insects can be extremely interesting. They may also provide insight into some of the many unanswered questions your members have about insects.

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.

Innovative Projects and Activities

Other ideas to consider for club activities are listed below. These are alternative activities that can be done in between, along with, or instead of the other meeting activities listed earlier. (For additional ideas on activities for younger 4-H'ers refer to the information on pages 4 and 5 of this book on working with 5-to 8-year-olds.) You and your 4-H'ers can:

- Make butterfly bowls and domes (glass containers filled with dried plants, galls and butterflies in a nice arrangement).
- Make plastic embedments (whole insects embedded in clear plastic).
- Do cartooning.
- Explore insect photography.
- Create insect puppets.
- Organize a quiz board.
- Make wing laminations (wings of insects sandwiched between clear contact paper).
- Make "bug" barns.
- Put together a bulletin board of insects in the news (this could be done as a club activity).
- Learn about butterfly gardens and plants.
- Visit insect terraria, aquaria and zoos.
- Do an exhibit on insect songs and sounds.
- Do insect word finds and crossword puzzles.
- Hold a contest with trivia questions.
- Conduct an insect "watch" or "count" to learn about insect populations.
- Study the possibilities of insects as human food.

Evaluating Member Progress

Evaluation is an important step in the learning process because it provides a review of knowledge and skills learned. The evaluation process also allows you to see how your members applied what they learned.

One of the most important parts of the evaluation process is the discussion that takes place between the 4-H member and leader. The best feature of these discussions is that they happen when needed. The opportunity may come before or after a presentation, when a new skill has been learned at a workshop or whenever the 4-H'er wants or needs to share feelings about an experience.

Once a project has been completed, it's helpful if you meet with each member to evaluate his or her project and discuss plans for the future. During this meeting, your discussion helps the 4-H'er think about his or her accomplishments and what he or she has learned from these experiences.

Some questions and areas for discussion can include:

- Did you find the experiences fun? What was fun?
- What was difficult? Boring? Most interesting?
- What things did you learn?
- How are you using the information you learned?
- Have you shared the information you've learned in this project with others?
- How well did you keep and maintain records?
- What could you have done differently to make it easier or more fun?



Awards and Incentives

EXHIBITING PROJECTS AT THE FAIR

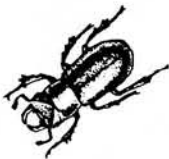
Exhibiting at the fair provides 4-H members with recognition and increases public awareness about insects. (Although as stated earlier, you should encourage your members to get involved in fun and valuable learning experiences that may not turn into fair projects.)

You and your club members should become familiar with the fairbook entry categories before members sign up for fair projects. This will help ensure that they sign up for the most appropriate entry for their project objectives. Knowing the criteria for each selected entry will also help prepare 4-H'ers for the judge's evaluation and feedback.

The State 4-H Entomology Developmental Committee has established suggested fairbook and judging guidelines for 4-H entomology projects. (See **Appendix A** for complete **Suggested Fairbook and Judging Guidelines**.) This information should be useful to you in helping your members prepare for the fair even if your county hasn't adopted these fairbook and judging guidelines. As a club, you and your members may want to use these guidelines to do a preliminary "judging" of projects before the fair. This will allow last minute corrections if needed. Be sure to not judge so harshly that members will not want to exhibit at all!

DISTRICT AND STATE AWARDS

Each year 4-H members can receive district, state and national recognition for their entomology accomplishments through the Michigan 4-H Awards Program. The first step the member must take is to fill out the computer form in December. Forms are available from county 4-H staff. (Completing this form is easier if 4-H members have kept good, accurate records of their progress and achievements!)



After the completed computer forms are reviewed, district award nominees are selected in each of the five different districts of the state. Each district nominee is required to assemble a record book which includes a national report form, a story and pictures. All district nominees are invited to attend the two-day Awards Assembly at Michigan State University in June. Selection of the state nominee is based on project accomplishments, leadership and citizenship. The state nominee earns the chance to attend the National 4-H Congress in Chicago and compete for a national scholarship. For more information on award and recognition opportunities, contact your county Cooperative Extension Service 4-H staff.

Resources

4-H PUBLICATIONS

The following 4-H publications are available from your county Cooperative Extension Service office.

(4-H 1120T) Career Ideas: Entomology

This sheet discusses how activities in a 4-H entomology project could lead 4-H'ers to an interest in careers in entomology, crop pest scouting, beekeeping, laboratory work and insect photography. (2 pages, Michigan 4-H, 1980)

(4-H 1231) 4-H Entomology Identification Labels

This sheet of identification labels is designed to simplify the task of labeling insect collections. Each label provides space for the location, collecting date, name of collector and name of insect. (1 page, Michigan 4-H, 1982)

(4-H 1331) Entomology Class and Order Labels

This sheet of class and order labels is designed to simplify the task of labeling insect collections. (1 page, Michigan 4-H, 1986)

(4-H 1335) Basic Entomology

This member's manual discusses what insects are, how they live and develop, and how to make an insect collection. (32 pages, Michigan 4-H, 1986)

(4-H 1336) Advanced Entomological Techniques

This member's manual acquaints the reader with unique collecting methods, advanced specimen preparation, specialty collections and ways to interact with other entomologists. (20 pages, Michigan 4-H, 1985)

(4-H 1406) Insect Life Cycle Studies

This bulletin is the third in a series of 4-H entomology manuals. It is designed to introduce 4-H members to rearing live in-

sects and studying insects in their natural environments. The manual will help members observe the behavior of insects, raise insects for profit or fun, and learn about insect life cycles under both artificial and natural conditions. (37 pages, Michigan 4-H, 1988)

(4-H 1393) 4-H Entomology Record and Report

This bulletin includes sections for recording collection and field notes, special entomology projects, special beekeeping projects, entomological studies, entomology experiments, and beekeeping purchases and sales. (6 pages, Michigan 4-H, 1986)

(4-H 1459) Kaleidoscope Overview Leader Guide

This booklet provides an overview of the Michigan 4-H Youth Programs 5- to 8-year-old curriculum, **Kaleidoscope**. **Kaleidoscope** materials focus on 5- to 8-year-olds' interests such as holidays, animals, how things work and things that happened long ago. (4 pages, Michigan 4-H, 1989)

(4-H 1460) Kaleidoscope:

Just Outside the Door Leader Guide

This leader's guide has plans for meetings on 12 different topics, with activities designed to help children learn more about the world that exists "just outside their door." Topics include water, plants, other people, insects and appropriate clothing for being outside. (40 pages plus a 7-page insert, Michigan 4-H, 1989)

(4-H 1461) Kaleidoscope:

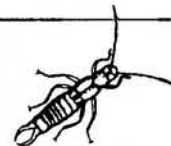
Just Outside the Door Member Packet

This packet is a companion to the **Just Outside the Door** meeting plans. It includes response sheets and mini-posters for children to take home to parents. (Folder with 30 sheets, Michigan 4-H, 1989)

4-H NEWSLETTER

Michigan 4-H Today

This tabloid-sized periodical covers all 4-H project areas. Contact your county Cooperative Extension Service office to get on the mailing list.



4-H AUDIOVISUAL MATERIALS

The following 4-H audiovisual materials can be scheduled through your county Cooperative Extension Service office.

(4H0233) 4-H Entomology Black Light

This black light is used for trapping insects. It can operate off a car cigarette lighter. (Kit, source unknown, 1987, junior and senior high school ages.)

(4H0378) Exploring the Curious World of Insects

This slide set is designed to promote interest in the 4-H entomology program for beginners and those already enrolled. (79 slides, tape, script, 15 minutes, National 4-H Council, 1977, all ages.)

(4H0116) 4-H Insect Collecting

This video illustrates insect collecting equipment and techniques for collecting insects in the field. It's most suitable for experienced collectors. (VHS video, 17 minutes, Clemson University, 1980, all ages.)

(4H0184) Insect Order Flashcards

Twenty-six North American insects are illustrated on these cards. The backs of the cards list the appropriate insect family, habitat and importance. (26 flashcards, Gull Lake Environmental Education Project, 1987, all ages.)

(4H0302) It's a Buggy World

This video tells the story of a bored boy who finds a new hobby and friends in the world of insect collecting. Boys and girls demonstrate the process of collecting and classifying insects. It's an excellent introductory video. (VHS video, 15 minutes, 1975, all ages.)



MATERIALS FROM OTHER MSU DEPARTMENTS

The following materials are available from the MSU Instructional Media Center. Write to 126 Instructional Media Center, Michigan State University, East Lansing, MI 48824, or phone (517) 353-3960. Rental fees are indicated below. Customers are responsible for round-trip shipping and insurance charges.

Eclosion

This film shows, through time-lapse and microphotography, a seemingly insignificant white sphere on a leaf. To the strains of classical and pop music, this mysterious growth matures from egg to caterpillar to brilliantly colored butterfly. (16mm film, 17 minutes, 1974, \$10.50, ages 12 and up)

Secrets of the Ant and Insect World

This film presents facts about the ant world, discussing in detail the honeycast, hunting and leafcutter ants. (16mm film, 13 minutes, 1956, \$8.75, all ages)

MATERIALS FROM OTHER ORGANIZATIONS

The following material is available from the Entomological Society of America, 9301 Annapolis Road, Lanham, MD 20706.

Coloring Fun With Insects by Edwin W. King (1983). This is a delightful insect coloring book. Cost is \$3.50 each, or \$2 each if 25 or more are ordered.

Discover Entomology. This is an eight-page illustrated brochure containing information on what entomology is, why people study insects and how to prepare for a challenging career as an entomologist. Single copies are free upon request from the ESA.

The following material is available from the Michigan Entomological Society, Department of Entomology, Michigan State University, East Lansing, MI 48824-1115, as part of a minimal annual membership fee. Send inquiries and fees to the attention of MES.

Entomology Notes. This is a 19-part series of single page project/fact sheets on various entomological topics. (Available to non-members at 15 cents per sheet.)

Great Lakes Entomologist. This is the society's quarterly technical journal.

Michigan Entomological Society Newsletter. This is a quarterly newsletter.

The following material is available from the Young Entomologists' Society (YES), 1915 Peggy Place, Lansing, MI 48910.

Insect World

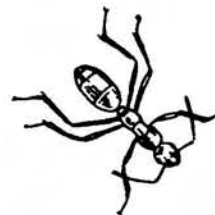
This is a bimonthly "funletter" for young people aged 6 to 14 who are interested in insects. There is an annual subscription fee. Send inquiries to the attention of YES.

YES Quarterly

This is an international journal devoted to young and amateur entomologists. There is a minimal annual membership and subscription fee. Send inquiries and subscriptions to the attention of YES.

YES International Entomological Resource Guide (Second Edition)

This 75-page resource guide is designed to help amateur entomologists locate entomological supplies and resources. This guide contains listings of businesses from around the world that sell entomological equipment, supplies, preserved specimens, live stock, books and publications, audiovisual materials, software and gift and novelty items. The guide also contains a list of entomological organizations and insect zoos. There is a minimal cost for each copy, payable to the Young Entomologists' Society. Send inquiries to the attention of YES.



Appendix A.

Suggested Fairbook Guidelines for 4-H Entomology Projects

The State 4-H Entomology Developmental Committee proposes that fair boards allow entomology projects to be exhibited under **any** of the following categories. Young people may exhibit in one level of each category.

Minimum Requirements

Entomology Collections:	Different species	Different orders	Identification
Basic Entomology I	25 adults	8	common or family name
Basic Entomology II	50 adults	11	common or family name
Basic Entomology III	100*	14	common or family name
Basic Entomology IV	175*	15	common and family name
Basic Entomology V	250*	16	common and family name
Basic Entomology VI	300*	16	common and family name
Basic Entomology VII	350*	17	common and family name
Basic Entomology VIII	400*	18	common and family name

*Credit given for adult specimens and/or immatures, phases or both sexes of one species.

Entomology Science: (Choose one)

- Option 1** **Special collections:** Collect, prepare and preserve 25 different insect immatures (nymphs and larvae) **or** 25 noninsect arthropods **or** 25 species from a single order. Include a one-page report.
- Option 2** **Economic entomology:** Collect, preserve and exhibit 30 different economic insects (pests and beneficials, adults and immatures) and include a one-page report on their relationship to human society.
- Option 3** **Entomological studies:** Can include slides, photos, observations, live specimen exhibits, identification demonstrations or drawings. Include a one-page report.
- Option 4** **Entomological experiments:** Can include experiments in biology, ecology, genetics or behavior of insects. Include a one-page report.

Special Entomological Skills: (Choose one)

- Option 1** **Illustration:** Prepare at least five illustrations (any medium) of insects showing form, habits, life cycle or other interesting information.
- Option 2** **Laminations:** Prepare at least 20 wing laminations, including a name for each species.
- Option 3** **Plastic embedments:** Prepare at least five plastic embedments of various insects and arthropods and include names of species.

Appendix B. Suggested Entomology Collection Evaluation and Feedback



BASIC ENTOMOLOGY COLLECTIONS

4-H member's name: _____ Age by December 31: _____

(Check one)	Classes	Required Specimens	Actual Specimens	Required Orders	Actual Orders	Required Identification
_____	Entomology I	25	_____	8	_____	common or family name
_____	Entomology II	50	_____	11	_____	common or family name
_____	Entomology III	100	_____	14	_____	common or family name
_____	Entomology IV	175	_____	15	_____	common and family name
_____	Entomology V	250	_____	16	_____	common and family name
_____	Entomology VI	300	_____	16	_____	common and family name
_____	Entomology VII	350	_____	17	_____	common and family name
_____	Entomology VIII	400	_____	18	_____	common and family name

Totals

Basic Requirements (30 points)	_____
Identification Accuracy (40 points)	_____
1. order identification (10 points)	_____
2. common name and/or family/species identification (30 points)	_____
Mounting of Specimens (10 points)	_____
1. pinning and pointing techniques (5 points)	_____
2. wing spreading (5 points)	_____
Labeling (10 points)	_____
1. proper alignment (5 points)	_____
2. style, neatness, legibility (5 points)	_____
Collection Arrangement (10 points)	_____
1. condition and alignment of specimens (5 points)	_____
2. display box and overall neatness (5 points)	_____
Total Score (100 points)	_____

Judge's name: _____

Please see reverse side for comments



Comments

Note To 4-H Member: This information is provided so that you may study the suggestions and comments given below and improve your collection for future years. If you have any questions about these comments, please discuss them with the judge.

	Expected	Actual	Good	Needs Improvement
1. Minimum number of orders	_____	_____	_____	_____
2. Minimum number of species	_____	_____	_____	_____
3. Mounting techniques				
a. location of pins			_____	_____
b. height of specimens			_____	_____
c. spreading technique			_____	_____
d. pointing technique			_____	_____
4. Labeling				
a. labels oriented correctly			_____	_____
b. proper spacing on pins			_____	_____
c. neatness and legibility			_____	_____
5. Neatness of collection				
a. alignment of rows and columns			_____	_____
b. consistent orientation of labels and specimens			_____	_____
c. neatness of lettering			_____	_____
d. condition of specimens			_____	_____
e. display box			_____	_____
6. Comments on incorrect identifications				

7. Additional comments



Appendix C. Evaluation Tips for 4-H Entomology Fair Judges

This short guide was prepared to assist you with the hope that it will make the job easier and ensure a positive learning experience for the 4-H member. If you have any questions about your duties as a fair judge, consult with a county 4-H staff person or fair exhibit superintendent.

4-H members participate in entomology projects for a variety of reasons, but they all should achieve the following goals:

1. Acquire information and understanding of insects in the environment.
2. Increase their awareness of beneficial and harmful effects of insect populations in the world.

3. Improve alertness to surroundings, observation and study skills.
4. Develop a hobby or special interest as a basis for positive self-esteem and interaction with others.
5. Develop neatness, orderliness, taxonomic skills (including the use of insect keys) and manual dexterity.
6. Create a curiosity to explore entomology related careers.

Keep these goals in mind when you evaluate 4-H entomology projects. **Be concerned about the quality of the project, but be more concerned about the quality of the learning experience!**

GENERAL PROCEDURES AND CONSIDERATIONS

Setting the stage for evaluation

Greet the 4-H member and try to make him or her feel at ease. Conduct the interview in a conversational manner.

Determine what the 4-H'er has learned. The project you are evaluating, as well as your evaluation and interview, are important learning tools. The exhibit, to a degree, indicates the member's growth and personal development. Try to judge both the quality of the project **and** the degree of learning. Look for signs of maturity, dexterity and attention to detail.

Questions you may want to ask include:

1. How old are you?
2. How much experience did you have before starting this project?
3. Were you able to learn from your leader or leaders, older club members or other resources?
4. What part of the project did you find most difficult?
5. What would you do differently if you were to do the project again?
6. How do you plan to use your new knowledge to assist younger 4-H members?

Determine the quality of work

Your judgment on the quality of work on the project is probably the best way to determine the outcome of this part of the evaluation. The "Entomology Collection Evaluation" form on pages 27 and 28 may help you make uniform and equal evaluations. At this point in the evaluation process a few specific questions about the project might be appropriate.

Evaluation wrap-up

Tell the member the outcome of his or her evaluation and why he or she received it. Completing the "Evaluation Feedback" section on the reverse side of the evaluation form will help you provide thoughtful, encouraging and constructive comments. Suggest ways to improve the exhibit, but always try to be encouraging and positive. You may be able to assist the member with plans for future projects through your comments.



ENTOMOLOGY PROJECT AND EXHIBIT EVALUATION: SPECIFIC POINTERS

Note: This section specifically refers to judging collections. Other projects and exhibits will have to be evaluated in a "free-style" manner.

The overall evaluation of an entomology collection takes place in five parts:

1. Basic requirements.
2. Identification accuracy.
3. Mounting technique evaluation.
4. Labeling.
5. Collection arrangement.

The evaluation form indicates the relative importance of each of these components.

A collection evaluation should operate something like the following; however, procedures may vary from county to county. An exhibit clerk or other assistant should check the 4-H'ers exhibit tag, count all the specimens in the box (orders and species) and indicate whether the collection meets the minimum requirements for the category of entry. The first thing you should do is examine the collection to see if all the identifications are correct, and then record the appropriate score on an evaluation form.

Keep in mind that there may be some allowable flexibility in ordinal classification. Although we encourage 4-H'ers to use the pre-printed order labels available through the county offices, you may find that they have applied different order names than you are used to, especially in the Orthopteroid and Hemipteroid complexes. This should be considered allowable because taxonomic classification schemes are not set in concrete and are subject to interpretation. You may, however, want to question the member about his or her reasoning behind the name selection to determine his or her level of understanding.

Next, examine the collection for accuracy and neatness in the various mounting techniques (pinning, pointing and wing spreading). Then, check the collection for alignment, neatness and style of labeling. The 4-H entomology collection is allowed to contain a mixture of one-label and two-label formats. This variation is a reflection of changes in project guidelines, **not** an inconsistency on the part of the 4-H member. Please **do not** penalize members for this variation.

Also look at the number of labels that identify someone other than the 4-H member as the one who collected the insect. The more the 4-H member is involved in doing his or her own collecting, the better. However, it's fine for them to encourage family and friends to be on the lookout for insects. If the member appears to be the only collector, you might let him or her know that it's all right to display insects caught by others. On the other hand, if most labels identify someone else as the collector, you may want to encourage them to become more involved. You might ask if they received the insects through trading or from the travels of friends or family members. Another thing to check are the collecting dates. How many insects have been added since last year?

Lastly, look at the overall collection arrangement. Evaluate for alignment and condition of specimens, overall neatness, and display box appearance. A wood display case with a glass top is strongly recommended, however, cigar, shoe, shirt or pizza boxes can also be used by beginning exhibitors. Record your evaluation and comments on an evaluation form.

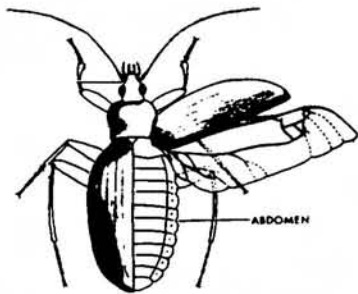
After completing your evaluation of the projects, take a few moments to offer some helpful comments and suggestions for improvement (if any are warranted). The feedback you provide can be very important to stimulating further development in this and other project areas. The comment section on the back of an evaluation form is probably the most convenient way to deal with this. Then, if time allows, take a moment to talk with the 4-H'er and briefly explain your evaluation and comments. Answer the member's questions as honestly and positively as possible.

We hope you enjoy your interaction with 4-H entomology members. You will find them knowledgeable and eager to learn. Your interaction with them can have a long-term effect on their progress and development in the entomology project area, so positive reinforcement is important!

Glossary

The following list consists of words you may find in entomology field guides and other reference books as well as words from the 4-H member's manuals. Don't be intimidated by all these words! You don't have to know them to be a good entomology leader, and this may serve as a useful reference in your reading and research.

Abdomen—the posterior section of the three main body divisions of an insect



Acute—pointed; forming an angle of less than 90 degrees

Aestivation—dormancy during a warm or dry season

Annulated—with ringlike segments or divisions

Antenna (pl. **antennae**)—a pair of segmented appendages located on the head above the mouth parts, and usually sensory in function

Anterior—front; in front of

Apical—at the end, tip or opposite to the base, that is, the apical segment of antennae is the segment most distant from the head

Apterous—wingless

Aquatic—living in water

Arista—large bristle, usually dorsally located, on the apical antennal segment

Aspirator—a suction device with which small insects may be picked up

Basal—at the base, opposite to apical near the point of attachment (of an appendage)

Basement membrane—a noncellular membrane underlying the epidermal cells of the body wall

Beak—the protruding mouth structures of a piercing-sucking insect; proboscis

Berlese funnel—an insect-collecting device that consists of a large funnel containing a piece of screen or hardware cloth, with a killing jar or container of alcohol below it; material, such as leaf litter, is placed in the funnel and heat from a light placed above the funnel forces the insects into the container

Bilobed—divided into two lobes

Brood—the individuals that hatch from the eggs laid by one mother; individuals that hatch at about the same time and normally mature at about the same time

Calypter (pl. **calypteres**)—one of two small lobes at the base of the wing located just above the halter (true flies only)

Campodeiform larva—a larva shaped like the thysanuran Campodea, that is, elongated and flattened with well-developed legs and antennae, and usually active

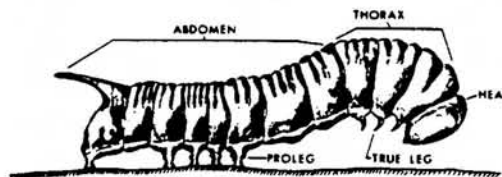
Cannibalistic—feeding on other individuals of the same species

Carina (pl. **cardinas**)—a ridge or keel

Carnivorous—feeding on the flesh of other animals

Caste—a form or type of adult in a social insect colony (such as a soldier or worker ant)

Caterpillar—an eruciform larva with distinct head capsule, chewing mouth parts, thoracic legs, abdominal prolegs and cylindrical in shape; the larva stage of a butterfly, moth, sawfly or scorpionfly



Caudal—pertaining to the tail or the posterior part of the body

Cell—a unit mass of protoplasm surrounded by a cell membrane and containing one or more nuclei or nuclear material; a space in the wing membrane partly (an open cell) or completely (a closed cell) surrounded by veins

Cervix—the neck; a membranous region between the head and prothorax

Chelicera (pl. **chelicerae**)—the anterior claw-like or pincerlike pair of appendages in arachnids

Chitin—a nitrogenous polysaccharide carbohydrate occurring in the cuticle of arthropods that is responsible for resilience of the body wall

Chrysalis (pl. **chrysalids** or **chrysalides**)—the pupa of a butterfly

Class—a taxonomic category; subdivision of a phylum or subphylum containing a group of related orders

Clypeus—a sclerite on the lower part of the face of insects between the frons and the labium

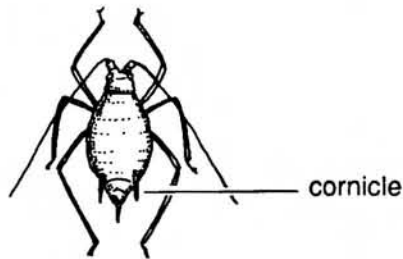
Cocoon—a silken case inside which the pupa is formed

Compound eye—the major insect eye located on the head and composed of many individual elements or ommatidia, each of which is represented externally by a facet; the facets represent separate lenses and may be hexagonal or somewhat circular in shape

Contiguous—touching each other

Corium—the elongated, usually thickened, basal portion of the front wing in members of the order Hemiptera (true bugs)

Cornicle—one of a pair of dorsal tubular structures extending from the posterior part of an aphid abdomen



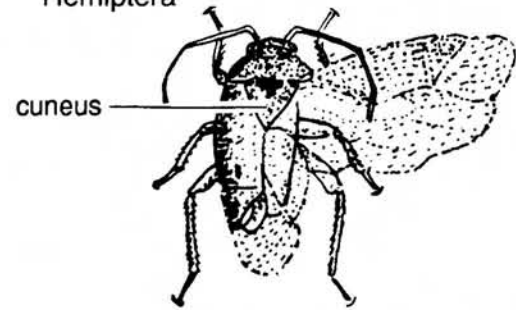
Coxa (pl. **coxae**)—the basal segment of the insect leg

Crawler—the active first instar nymph of a scale insect

Crochets (pronounced **croshays**)—hooked spines at the tip of the prolegs of lepidopterous larvae (butterflies, moths)

Cross vein—a vein connecting adjacent longitudinal veins

Cuneus—a more or less triangular apical piece of the corium set off from the rest of the corium by a suture; part of the hemelytron in Hemiptera



Cursorial—fitted for running; running in habit

Cuticle—the noncellular outer layer of the body wall of an arthropod that is surrounded by veins

Dentate—toothed, or with toothlike projections

Diapause—a period of arrested development

Diurnal—active during the daytime

Dormancy—a state of quiescence or inactivity

Dorsal—top or uppermost; pertaining to the back or upper side

Drone—the male bee

Ecdysis (pl. **ecdyses**)—molting; the process of shedding the exoskeleton

Ectoparasite—a parasite that lives and feeds on skin of the host

Elateriform larva—a larva resembling a wireworm, that is, slender, heavily sclerotized, with short thoracic legs and few body hairs

Elytron (pl. **elytra**)—a thickened, leathery or horny front wing found in Coleoptera, Dermaptera and some Homoptera

Emarginate—notched or indented

Emergence—the act of the adult insect leaving the pupal case or the last nymphal skin

Epicuticle—the very thin, nonchitinous, external layer of the cuticle

Epidermis—the cellular layer of the body wall which secretes the cuticle

Epipleura (pl. **epipleurae**)—the bent-down lateral edge of the elytron (Coleoptera)

Eruciform larva—a caterpillar; a larva with a more or less cylindrical body, a well developed head, and with both thoracic legs and abdominal prolegs

Exocuticle—the layer of the cuticle just outside the endocuticle, between the endocuticle and the epicuticle

Exoskeleton—a skeleton or supporting structure on the outside of the body

Exuviae—(always plural)—the cast skin of an arthropod

Family—a taxonomic category; a subdivision of an order, suborder or superfamily containing a group of related genera, tribes or subfamilies; family names end in -idae

Femur (pl. **femora**)—the third leg segment located between the trochanter and the tibia

Fossorial—fitted for or having the habit of digging (for example, mole crickets)

Frass—plant fragments made by a plant feeding insect, usually mixed with excrement

Frons—the head sclerite bounded by the frontal and epistomal sutures and including the median ocellus

Front—the portion of the face between the antennae, eyes and ocelli; the frons

Furcula—the forked springing apparatus of the Collembola



Gall—an abnormal growth (tumor) of plant tissues caused by the stimulus of an insect, fungus, bacteria or another plant

Ganglion (pl. **ganglia**)—a knotlike enlargement of a nerve containing a coordinating mass of nerve cells

Gena (pl. **genae**)—the part on each side of the head below and behind the compound eyes and between the frontal and occipital sutures; the cheek

Genitalia—the sexual organs and associated structures; the external sexual organs

Genus (pl. **genera**)—a taxonomic category; a group of closely related species; the first name in a binomial or trinomial scientific name; names of genera are Latinized, capitalized, and when printed are italicized

Glabrous—smooth, without hairs

Gregarious—living in groups

Grub—a scarabaeiform larva; a thick-bodied larva with a well-developed head

Halter (pl. **halteres**)—a small knobbed structure on each side of the metathorax representing the hind wings in Diptera and used for balance

Head—the anterior body region; the section which bears the compound eyes, antennae, ocelli and mouth parts

Herbivorous—feeding on plants

Hibernation—dormancy during the winter

Honeydew—liquid discharged from the anus of certain Homoptera

Horny—thickened or hardened

Host—the organism in or on which a parasite (or parasitoid) lives; the plant on which an insect feeds

Humerus (pl. **humeri**)—the shoulder; the lateral angle of the forewing

Imago (pl. **imagoes** or **imagines**)—the adult or reproductive stage of an insect

Instar—the stage of an insect between successive molts; the first instar is the stage between hatching and the first molt

Integument—the outer covering of the body

Joint—an articulation of two successive segments or parts

Labial palp—one of a pair of small feelerlike or antennalike structures arising from the labium

Labium—one of the mouth structures; the lower lip

Labrum—the upper lip lying just below the clypeus

Larva (pl. **larvae**)—the immature stages, between the egg and pupa, of an insect having complete metamorphosis; an immature stage differing radically from the adult

Lateral—on or pertaining to the side (that is, the right or left side)

Leaf miner—an insect that lives and feeds on the leaf cells between the upper and lower surfaces of the leaf

Longitudinal—lengthwise of the body or of an appendage

Looper—a caterpillar that moves by looping its body, that is, placing the posterior part of the abdomen next to the thorax and then extending the anterior part of the body forward; a measuringworm

Maggot—a legless larva without a well-developed head capsule; a dipterous larva

Malpighian tubules—excretory tubes that arise near the anterior end of the hindgut and extend into the body cavity

Mandible—jaw; one of the anterior pair of the paired mouth structures

Maxilla (pl. **maxillae**)—one of the paired mouth structures immediately posterior to the mandibles

Maxillary palp—a small feelerlike structure rising from the maxilla

Membrane—a thin film of tissue, usually transparent; that part of the wing surface between the veins

Mesothorax—the middle or second segment of the thorax

Metamorphosis—change in form during development

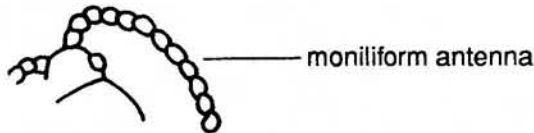
Metathorax—the third or posterior segment of the thorax

Millimeter—0.001 meter, or 0.03937 inch (about 1/25 inch)

Mimicry—the ability of an animal to imitate or mimic another species of animal or plant in form and color, sometimes behavior as well

Molt—a process of shedding the exoskeleton; ecdysis; to shed the exoskeleton

Moniliform—beadlike, with rounded segments; moniliform antenna



Naiad—an aquatic, gill breathing nymph

Nocturnal—active at night

Nodus—a strong cross vein near the middle of the costal border of the wing

Notum (pl. **nota**)—the dorsal surface of a body segment (usually used when speaking of the thoracic segments)

Nymph—an immature wingless stage (following hatching) of an insect that does not have a pupal stage

Occiput—the dorsal posterior part of the head

Ocellus (pl. **ocelli**)—a simple eye of an insect or other arthropod

Ommatidium (pl. **ommatidia**)—a single unit or visual section of a compound eye

Ootheca (pl. **oothecae**)—the covering or case of an egg mass (Orthoptera)

Order—a taxonomic category; a subdivision of a class or subclass containing a group of related families

Ovipositor—the egg laying apparatus; the external genitalia of the female

Palp—a segmented extension, antennalike, located on the maxillae and the labium

Parasite—an animal that lives in or on the body of another living animal (its host) for its entire life cycle (obligate parasite) or for only part of the life cycle (temporary parasite); a parasite usually does not kill its host or consume a large proportion of its tissue

Pectinate—with branches or processes like the teeth of a comb; pectinate antenna; pectinate tarsal claw

Pedicel—the second segment of the antenna; the stem of the abdomen between the thorax and the gaster (ants)

Petiole—a stalk or stem; the narrow stalk or stem by which the abdomen is attached to the thorax (Hymenoptera)

Pheromones—ectohormone, a substance given off by an animal that causes a specific reaction by individuals of the same species; includes trail substances, sex attractants and alarm substances

Phylum (pl. **phyla**)—a taxonomic category; one of the dozen or so major divisions of the animal kingdom

Pleurite—a lateral or pleural sclerite

Pleuron (pl. **pleura**)—the lateral area of the thoracic segment

Plumose—featherlike

Point—a small triangle of stiff paper used in mounting small insects

Posterior—hind or rear

Predator—an animal that attacks and feeds on other animals (its prey), usually animals smaller or less powerful than itself; the prey is usually killed quickly and mostly or entirely eaten; many prey individuals are eaten by each predator

Proboscis—the extended beaklike mouth parts

Proleg—one of the fleshy abdominal legs of certain insect larvae

Pronotum—the dorsal sclerite of the prothorax

Prothorax—the anterior of the three thoracic segments

Pubescent—downy, covered with short fine hairs

Pupa (pl. **pupae**)—the stage between the larva and the adult in insects with complete metamorphosis; a nonfeeding and usually inactive stage

Puparium (pl. **puparia**)—a case formed by the hardening of the next to the last larval skin in which the pupa is formed

Raptorial—fitted for grasping prey (forelegs of praying mantid)

Reproductives—the members of an insect caste system, male and female, capable of reproducing; their numbers are usually limited, males are sometimes termed kings, females usually are termed queens; found in Isoptera (termites) and some Hymenoptera

Rhabdom—a rodlike structure formed of the inner surfaces of adjacent sensory cells in the ommatidium of a compound eye

Riker mount—a thin, glass-topped exhibition case filled with cotton

Scape—the basal segment of the antenna

Scarabaeiform larva—a usually sluggish grublike larva with a thickened, cylindrical body and a well-developed head and thoracic legs without prolegs

Scientific name—a Latin name, internationally recognized, of a species or subspecies; the scientific name of a species consists of the generic and specific name and the name of the describer of the species; the scientific name of a subspecies consists of generic, specific and subspecific names and the name of the describer of the subspecies; scientific names (excluding authors' names) are always printed in italics

Sclerite—a hardened body wall plate bounded by sutures or membranous areas

Sclerotin—a horny substance located in the cuticle of insects, responsible for hardness of the body wall

Sclerotized—hardened

Scutellum—a sclerite of a thoracic notum; the mesoscutellum, appearing as a more or less triangular sclerite behind the pronotum (Hemiptera, Homoptera, Coleoptera)

Segment—a subdivision of the body or of an appendage, between joints or articulations

Serrate—toothed along the edge like a saw

Sessile—attached or fastened, incapable of moving from place to place; attached directly, without a stem or petiole

Seta (pl. *setae*)—a bristle, located on the external surface of some part of the body

Setaceous—bristlelike

Species—a group of individuals or populations that are similar in structure and physiology and are capable of interbreeding and producing fertile offspring, and which are different in structure, or physiology or both from other such groups and normally do not interbreed with them

Spine—a thornlike outgrowth of the cuticle

Spinneret—a structure with which silk is spun, usually fingerlike in shape

Spiracle—an external opening of the tracheal system; a breathing pore

Spittle—the waterlike material that is secreted by the nymphs of the spittlebugs or frog-hoppers (Homoptera, Cercopidae); the material is used for protection and is secreted from anal glands

Stadium (pl. *stadia*)—the period between molts in a developing insect

Sternite—a subdivision of a sternum

Sternum (pl. *sterna*)—a sclerite on the ventral side of the body; the ventral sclerite of an abdominal segment

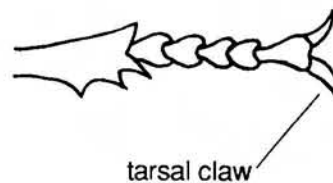
Stigma (pl. *stigmata*)—a thickening of the wing membrane along the costal border of the wing near the apex

Stylet—a needlelike structure; one of the piercing structures in sucking mouth parts

Stylus (pl. *styli*)—a short, slender, fingerlike process

Subspecies—a subdivision of a species, usually a geographic race; the different subspecies of a species are ordinarily not sharply differentiated and intergrade with one another and are capable of interbreeding

Suture—an external linelike groove in the body wall or a narrow membranous area between sclerites; the line of juncture of the elytra (Coleoptera)



Tarsal claw—a claw at the apex of the tarsus

Tarsal formula—the number of tarsal segments on the front, middle and hind tarsi, respectively

Tarsus (pl. *tarsi*)—the leg segment beyond the tibia, consisting of one or more segments or subdivisions

Tegmen (pl. *tegmina*)—the thickened or leathery front wing of an orthopteran

Teneral—a term applied to a recently molted, pale, soft-bodied individual

Tergum (pl. **terga**)—the dorsal surface of any body segment
Terminal—at the end; at the posterior end (of the abdomen); the last of a series
Terrestrial—living on land
Thorax—the body region behind the head which bears the legs and wings
Tibia (pl. **tibiae**)—the fourth segment of the leg between the femur and the tarsus
Trachea (pl. **tracheae**)—a tube of the respiratory system ending externally at a spiracle and terminating internally in the tracheoles
Tracheoles—the fine terminal branches of the respiratory tubes
Transverse—across, at right angles to the longitudinal axis
Tribe—a subdivision of a subfamily containing a group of related genera; names of tribes end in -ini
Trochanter—the second segment of the leg between the coxa and the femur

Truncate—cut off square at the end
Tympanum (pl. **tympana**)—a vibrating membrane; an auditory membrane or eardrum
Vein—a thickened line which provides support in the wing of the insect
Ventral—lower or underneath; pertaining to the underside of the body
Vermiform larva—a legless maggotlike larva without a well-developed head
Vertex—the top of the head
Vestigial—small, poorly developed, degenerate, nonfunctional
Viviparous—giving birth to live young, not egg laying (for example, aphids)
Wireworm—an elateriform larva; a larva that is slender, elongate, heavily sclerotized with a few body hairs and with thoracic legs but without prolegs; the larva of a click beetle

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