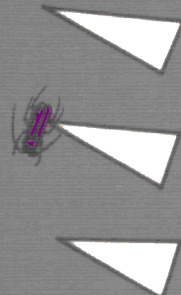
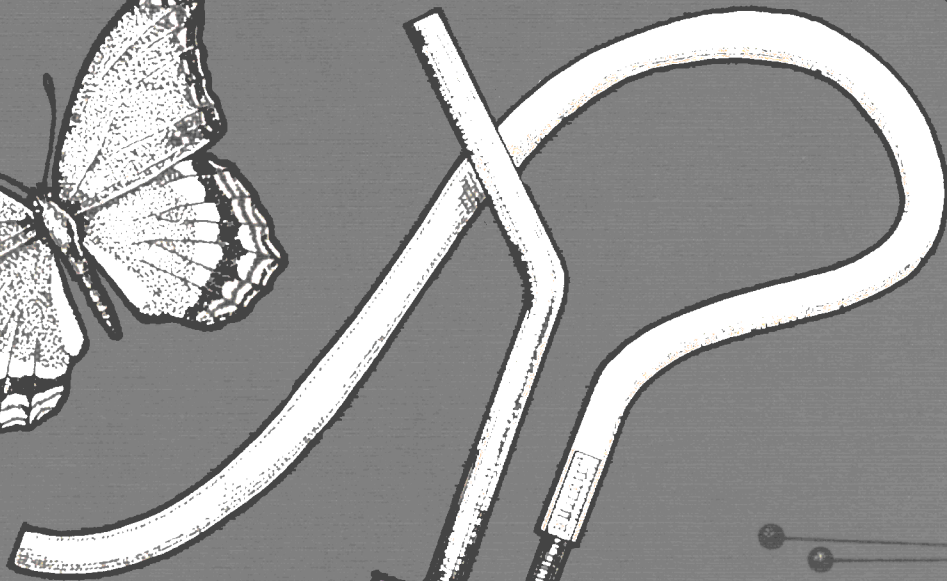


# INSECT LIFE CYCLE STUDIES

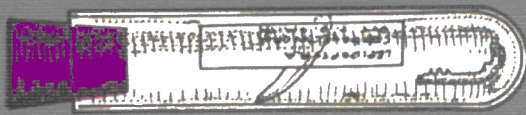
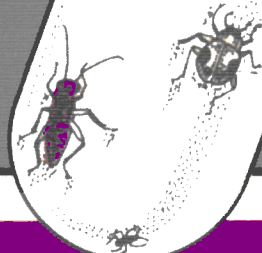
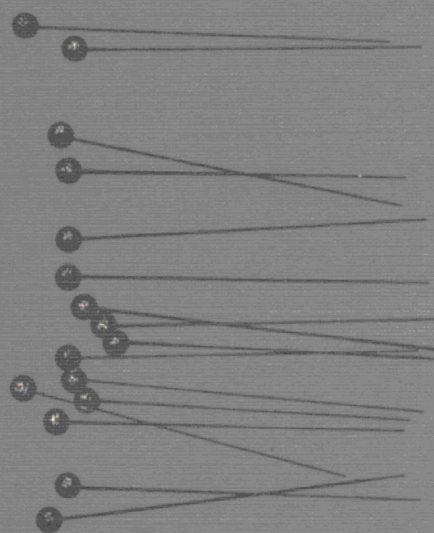
## 3 Manual



EastLansing, MI  
29 June, 1988  
Coll. 30-9mm  
Ex. Apple

Coll. 30mm diam  
Apple Leaf Beetle  
Eggs, 10-15 eggs

EastLansing, MI  
1 June, 1988  
Coll. M.M. Reiter  
Ex. Potato



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# AUTHOR

This manual was written by Gary A. Dunn, Extension 4-H Youth Entomology Specialist.

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# Welcome to 4-H Entomology

Welcome to the 4-H entomology project. This project will introduce you to many new and exciting experiences. It will be fun and will help you learn how important insects are in the lives of everyone. It may even help you prepare for the study of insects as your life's work.

This manual gives instructions for studying live insects and their life cycles through rearing projects and field studies. There are addi-

tional 4-H entomology publications for beginners and people interested in other entomological projects. Information on these publications can be obtained from your leader or county 4-H staff.

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## Introduction

Entomology (en-toe-mol-o-gee) is from the Greek word **entomo**, meaning insect. Entomology is the science dealing with the study of insects. A scientist who specializes in the study of insects is known as an entomologist. However, you do not need to be an entomologist to learn something about the important and fascinating world of insects.

The main objective of this manual is to introduce you to rearing live insects and studying them in their natural environments. The manual will help you learn the skills necessary for studying live insects. You can use these skills to: (1) observe the behavior of insects, (2) raise insects for profit or fun, or (3) learn about

insect life cycles under both artificial and natural conditions.

This manual contains some entomological terms that may be unfamiliar to you. Explanations of these terms can be found in **4-H Entomology Series Manual 1: Basic Entomology** (4-H 1335) or any book on general entomology.

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# Rearing Insects

Most entomology projects emphasize the study and handling of dead specimens. Most people who set up their own insect collections are careful observers, as well as collectors. They know that the more they learn and understand about insect activity, the easier it will be for them to collect the insect specimens they prize. But many collectors seem to forget that insects are living creatures. Collecting and observing insects are both extremely important parts of entomology. Insects in collections can be studied to learn more about how separate species are alike and different, and how and why insect populations are distributed around the world. They are also help-

ful in learning the reasons for changes in insect populations. Collections are important!

Entomology is, of course, a biological science. To fully understand insects, people must have firsthand knowledge of insect ways and means of living: how insects feed, grow, behave, disperse and reproduce. This knowledge can only be gained by studying live insects.

---

## WHY REAR INSECTS?

There are several advantages to making insects the focus of a "live animal" study. Most insect species complete their life cycles in relatively brief spans. They take up little space, and their maintenance requirements are fairly simple. Finally, insects make fascinating, low-cost (often free) 4-H projects.

Rearing insects can provide you with valuable learning experiences. Observing insects as they grow and change from one stage to another is certainly interesting, but there is much more to be gained. You can improve your reading skills and your ability to follow directions. You can also learn to measure wood, screening and other building materials as you build cages and other equipment for your live insect studies.

Your live insect studies will help you gather important scientific information. You can learn a great deal about insect life cycles and behavior by closely observing insects. You'll be able to answer questions about the duration of insect life stages (perhaps under varying conditions), and insect mating behavior and response to environmental stimuli. In short, insects can easily be used as laboratory animals in your scientific experiments.

---

## MAKING MONEY WITH "BUGS"

Did you know that you can make money raising and selling insects? Well it's true!

**Beekeeping.** You may already be familiar with the potential of honey bees as a source of income. In addition to selling honey and beeswax, many beekeepers also rent their hives to farmers who need bees to pollinate their crops. Hive rentals become more impor-

tant every day because soon there may not be enough wild bee colonies in Michigan to pollinate all the crops that need it. Beekeeping can be quite involved, so you will probably need the guidance of an experienced beekeeper. Your Cooperative Extension Service (CES) office can help you find the 4-H beekeeping leader nearest you. There are many bro-

chures and publications on beekeeping, so it won't be covered in this manual.

**Fish bait.** Many insects are used as bait by anglers. The popularity of any bait insect depends on the area where you live. You'll need to find out which insects are in demand in your area. Popular fish bait insects include crickets, wax moth larvae (waxworms) and mealworms. Instructions for rearing these insects begin on page 8.

**Pet food.** Many people keep lizards and tarantulas as pets, and insects are the primary food source for these animals. Many of the insects that can be used for fish bait, especially crickets and mealworms, can also be used to feed exotic pets.

**Biological supply companies.** Some biological supply companies buy selected insects in large quantities for resale to schools and research institutions. The specimens are

then used for teaching or biological research. The insect needs of these companies are constantly changing, so contact them for an up-to-date list of the insect species they need and for shipping instructions. The names and addresses of companies that buy insect specimens are listed in "Appendix A—Companies That Buy Live Arthropods" on page 36.

---

# General Considerations

It is very important to match the natural habitat of the insects you want to rear, including their preferred food and proper light, temperature and humidity conditions. You will need a cage or other container in which to rear most insects. The type of container you use will depend on the species you decide to raise. But no matter what type of rearing chamber you select, it must be constantly tended. For example, most insects won't eat dried leaves, and without a constant fresh food supply the insects will quickly die.

Insects that feed on live plants can be caged over potted plants or fed fresh material from their host plants. With a little ingenuity, a suitable cage can be designed to accommodate your rearing plans. The important thing is to keep the cage tight enough to restrain the insects and still provide enough ventilation that the container doesn't "sweat." Loose, slightly moist soil and leaf litter should also be provided in case the insect pupates in or on the ground.

Terrestrial insects and scavengers do well in containers with a small amount of sand or soil in the bottom. Keep the cage clean and control moisture to prevent molds and diseases.

You can rear insects that infest plants (seeds, galls, leaves or stems) or other materials by placing the infested object in an enclosed container. Don't let such materials get too dry or too moist, or the materials and specimens will mold. If you want to extract sample specimens from such a culture, use an opaque container (one that you can not see through) and insert an open-ended glass vial through a hole (just big enough for the jar) in one end of the container. As adult insects emerge from the infested material, they will be attracted to the light coming through the vial. Once they are in the second container, you can remove them for study or to add them to

your personal insect collection. "Appendix B—Classification of Commonly Reared Arthropods" (page 36) will help you classify many of the insects discussed in this manual.

You may also find it interesting to dig large larvae and pupae out of soil or rotten logs and rear them to the adult stage. The larvae probably won't need to be fed as long as you keep some of the rotten wood or soil in the container with the specimens. Place the larvae and soil or wood in a closed jar or other container to retain moisture, and check them periodically. You may be surprised to find freshly emerged specimens of some of the largest and least common beetles and other insects. Remember that the life cycles of some of these large insects may be quite long, so you'll have to be patient. As long as the larvae are plump, moist and healthy-looking, they will probably develop to adulthood. Unhealthy, diseased or dead individuals should be removed from the container and disposed of.

Collecting moth cocoons and butterfly chrysalids is another interesting activity. You may get lucky and find a full-grown caterpillar that is just about to transform into a pupa. These can be collected and observed until the adult butterfly or moth emerges. Since some Lepidoptera overwinter as pupae you may have to wait until the following spring to see them emerge.

---

## SELECTING INSECTS

Some important questions you need to consider when you are deciding on an insect species to rear are listed below.

1. Is the insect an appropriate size for the space you have?
2. Is the insect harmless? Will it cause problems if it escapes?
3. Are there interesting features about the appearance, behavior or life cycle of the species?

4. Is the insect adaptable to culturing? Will it mate in captivity?

Another important step is getting permission from your parents or guardians to raise the insects! Some of the questions mentioned above are answered in the rearing instructions in this manual. The others can only be answered through your experimentation.

---

## OBTAINING LIVE INSECTS

You can start your live insect cultures two ways: purchase insects from biological supply companies or collect your own. (A list of insect and rearing equipment suppliers is included in "Appendix C—Sources of Live Arthropods" on page 36.) The choice between buying or collecting is often influenced by how much money you have, the season you want to start

your project, the species you decide on and how much time you have to hunt for insects. Obviously, gathering your own specimens costs virtually nothing, but more importantly, it helps you understand the habitat and natural conditions of the species you are raising.

---

## COLLECTING LIVE INSECTS

The equipment you will need to gather insects is not elaborate. All you really need are your fingers and a collecting carton. However, you may also want to use a garden trowel, forceps, aspirator, insect traps or other tools, depending on the insects you wish to collect. (See **4-H 1336, 4-H Entomology Manual 2: Advanced Entomological Techniques**, for more details.)

Insects collected in the field should be carried in a special collecting carton. Ordinary plastic, glass and metal containers are not satisfactory because they don't "breathe." This can cause your specimens to overheat, mold and die. The best collecting containers are made from quart-sized, cylindrical, unwaxed cardboard cartons (like an ice cream carton). Cut out the bottom of the carton and replace it with window screen or cheesecloth. Cut a  $\frac{5}{8}$ -inch to 1-inch hole in the side of the carton about one-third of the way down from the screened end. The exact location of this hole is not critical. Block the hole with a cork.

When you use the collecting carton, hold it so that the screening is at the top and the

removable lid is at the bottom. Put the insects in the carton through the circular hole in the side. Since insects tend to move "uphill," you will find that they congregate at the top of your carton. This means your insects won't try to escape every time you open the entryway.

You'll probably want several collecting containers, since you may need one or more for storage at any given time. Cartons should be available locally from paper manufacturers or from retail stores that handle ice cream, oysters, delicatessen items or other perishable goods. Cylindrical cartons are best, but those with tapered sides can also be used.

To reduce the insect activity in your collecting carton, cover it loosely with a dark cloth. When it's time to transfer the specimens to a rearing cage you may need to further reduce their activity to keep them from escaping or being hurt. You can do this by placing the insects (in their container) in the refrigerator (not the freezer) until their activity slows, then you can easily place them in a rearing cage.

# REARING CAGES

Many kinds of containers and cages can be used to hold insects for rearing. Use whatever type is available and that suits your needs. "Appendix D—Sources of Rearing Supplies and Equipment" (page 37) will help you locate any equipment you need to purchase. A good insect rearing cage should be lightweight, sturdy, escape-proof and well-ventilated. It should also allow you to watch the insects

easily. Cages constructed of lightweight wood or aluminum and covered with screening make the best all-around rearing cages (see fig. 1 for ideas).

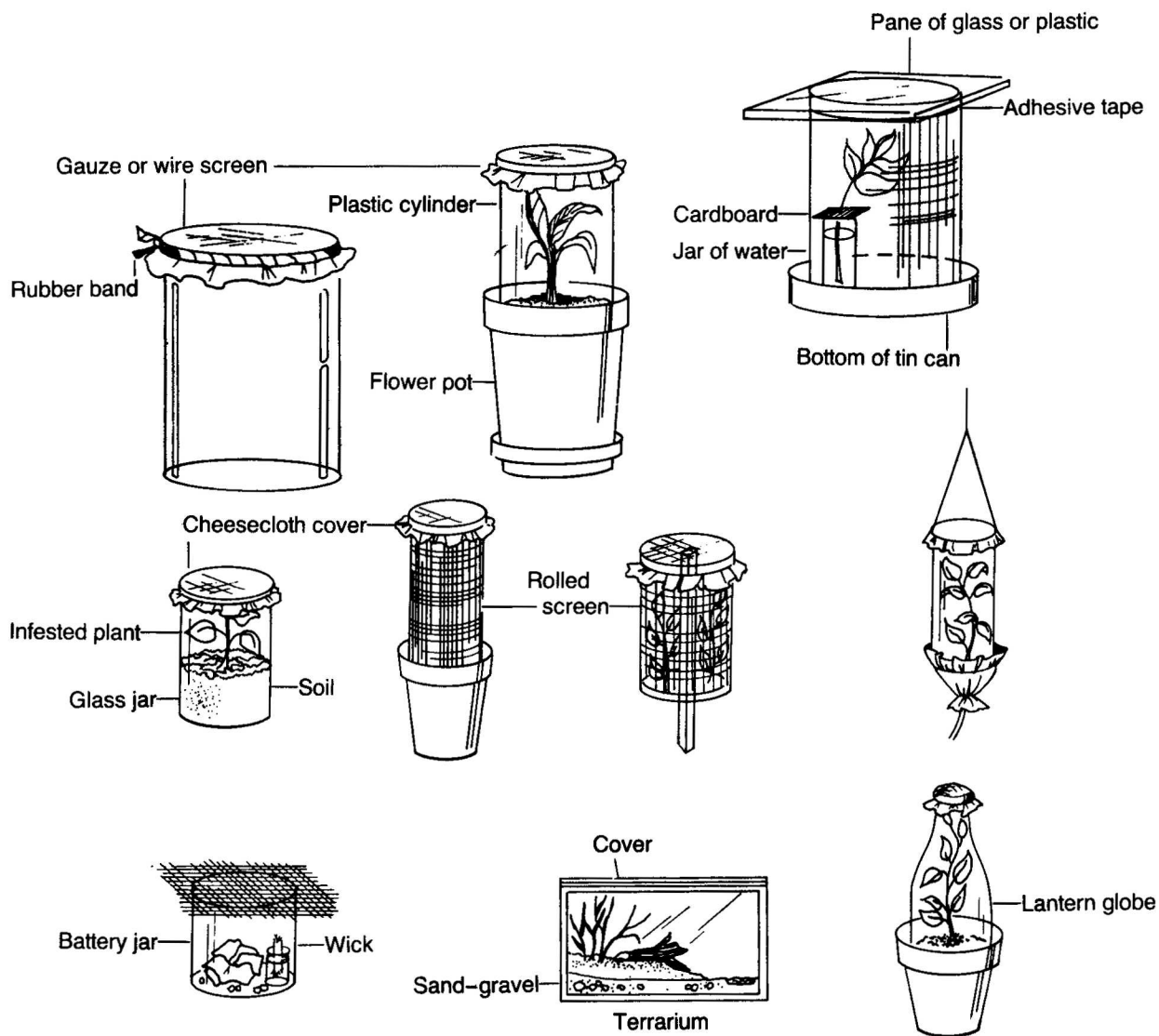


Figure 1. Examples of equipment for rearing insects.



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## FEEDING YOUR INSECTS

Your insects will require a constant supply of high quality food. Plant eating insects will need a fresh supply of foliage from their host plants. Many other insects can be reared on commonly available food items such as dog food, vegetables, honey, flour and food scraps. Predatory insects need live prey. This means you'll either have to culture a colony of

acceptable prey insects or collect live insects from outdoors. You can simplify this task by using insect-collecting traps (pitfall, blacklight, Malaise, windowpane, etc.) to gather the necessary insects. You can also collect leaf litter samples and run them through Berlese funnels to sort out living insects.

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## WATERING YOUR INSECTS

Most insect cultures need an ample supply of clean drinking water to ensure their successful growth and development. Several ways to provide water to your insects are outlined below. All of the methods are easy to use and require a minimum of maintenance. No matter what method you use, however, you must always keep the "drinking fountain" clean and mold-free.

**Fountain 1 (fig. 2).** Fill a tall, slender glass or plastic jar with clean water. Place several layers of cheesecloth over the jar opening and secure it with an elastic band. Turn the jar upside down in a shallow dish and place it in your rearing cage.

**Fountain 2 (fig. 3).** Use a jar similar to the one described above. You will also need a shallow watch glass, petri dish, plastic lid or large jar lid. Fill the jar with clean water. Cut several pieces of paper toweling or absorbent cotton batting to fit inside the lid. Set the lid, with the absorbent material in it, on top of the jar and turn the whole assembly upside down. The insects will drink from the absorbent material, which will also prevent them from drowning.

**Fountain 3 (fig. 4).** Use a jar or large vial similar to the one used for fountain 2, except this time you must have a lid or cork big enough to fit the container's opening. Bore a hole in the lid or cork and insert a dental wick or similar roll of absorbent cotton or other material into the lid or cork. Fill the jar or vial with clean water and lay it on its side in the rearing cage. The insects will drink from the moist wick.

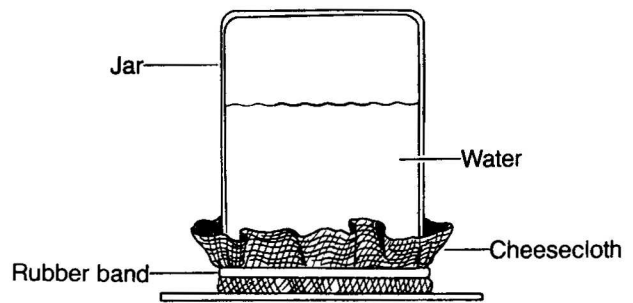


Figure 2. Insect water fountain 1.

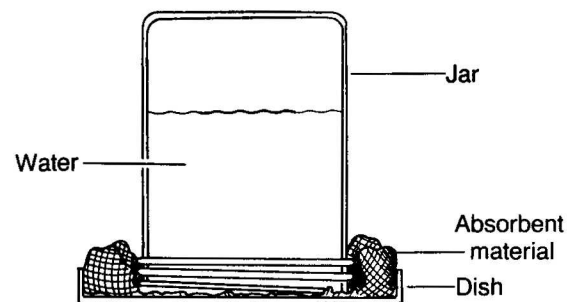


Figure 3. Insect water fountain 2.

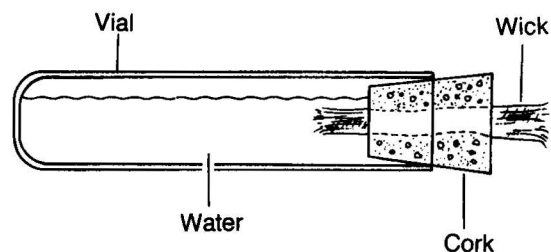


Figure 4. Insect water fountain 3.

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