
AUTHOR

This manual was written by Judy A. Ratkos, Associate Program Leader, 4-H Youth Programs, with a great deal of input from the State 4-H Entomology Developmental Committee.



CONTENTS

Welcome to 4-H Entomology	1	Member's Manual 3: Insect Life	
How to Use This Manual	1	Cycle Studies	19
4-H Entomology Project Objectives		Innovative Projects and Activities	21
(Core Curriculum)	2	Evaluating Member Progress	21
Role of the Leader	3	Awards and Incentives	22
Working With Youth	4	Resources	23
Teaching Techniques	6	Appendix A—Suggested Fairbook Guide-	
Planning and Conducting Your		lines for 4-H Entomology Projects	26
Club Program	8	Appendix B—Suggested Entomology	
Member's Manual 1: Basic Entomology ..	10	Collection Evaluation and Feedback ...	27
Member's Manual 2: Advanced		Appendix C—Evaluation Tips for	
Entomological Techniques	16	4-H Entomology Fair Judges	29
		Glossary	31

ACKNOWLEDGMENTS

The manual was edited by Susan Malott, Publications Editor, 4-H Youth Programs. The illustrations were done by Marian Reiter, Graphic Artist, 4-H Youth Programs.

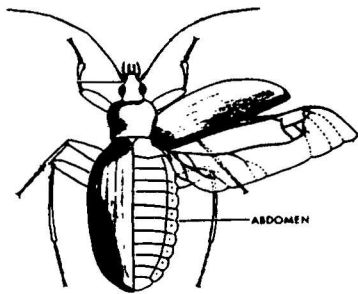
MICHIGAN STATE
UNIVERSITY
EXTENSION

MSU is an affirmative-action, equal-opportunity employer. Michigan State University Extension programs and materials are open to all without regard to race, color, national origin, gender, gender identity, religion, age, height, weight, disability, political beliefs, sexual orientation, marital status, family status or veteran status. Issued in furtherance of MSU Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Thomas G. Coon, Director, MSU Extension, East Lansing, MI 48824. This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by MSU Extension or bias against those not mentioned. The name 4-H and the emblem consisting of a four-leaf clover with stem and the "H" on each leaflet are protected under Title 18 U.S.C. 707. 2P-1M-4:95-BP-RM

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

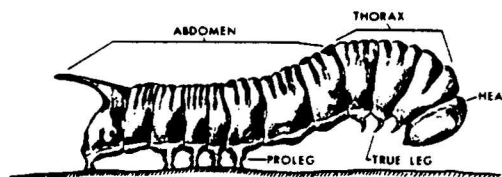
Cannibalistic—feeding on other individuals of the same species

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

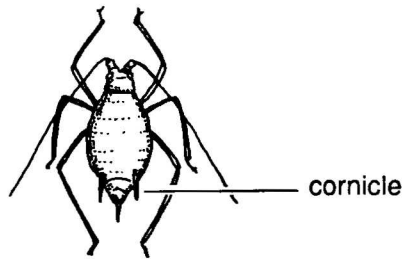
Cocoon—a silken case inside which the pupa is formed

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



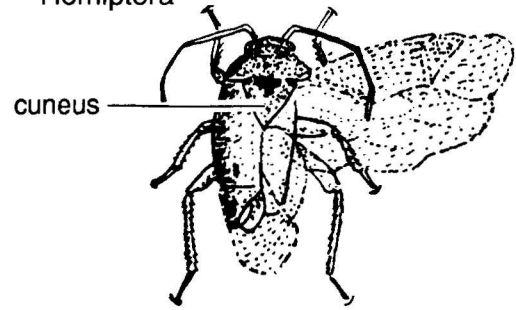
Coxa (pl. **coxae**)—the basal segment of the insect leg

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

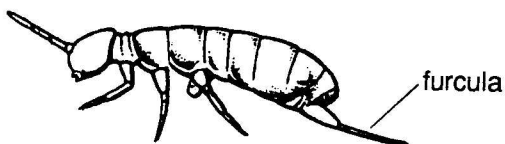
Fossorial—fitted for or having the habit of digging (for example, mole crickets)

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

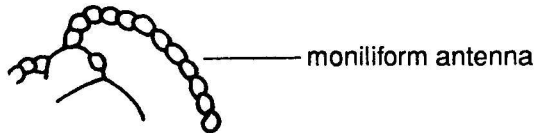
Metathorax—the third or posterior segment of the thorax

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

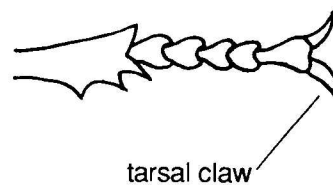
Stigma (pl. *stigmata*)—a thickening of the wing membrane along the costal border of the wing near the apex

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

GLOSSARY REFERENCES

1. Borror, D. J., DeLong D. M. and Triplehorn, C. E., 1981. *An Introduction to the Study of Insects*. Sanders College Publication, 827 pp.
2. Torre-Bueno, J. R., 1937. *A Glossary of Entomology*. Science Press Printing Co., Lancaster, PA, 336 pp.
3. Lapedes, D. N., 1979. *Dictionary of the Life Sciences*. McGraw-Hill Book Co., New York, NY, 907 pp.



4-H Youth Programs
Children, Youth and Family Programs
Michigan State University Extension

