Unit G: Pest Management

Lesson 4: Managing Insects

Student Learning Objectives: Instruction in this lesson should result in students achieving the following objectives:

1. Describe the biology of insects.
2. Explain the classification of insects.
3. Classify nematodes and describe their biology.
4. Describe methods of insect and nematode management.

Recommended Teaching Time: 2 hours

Recommended Resources: The following resources may be useful in teaching this lesson:

- A PowerPoint has also been developed for use with this lesson plan

List of Equipment, Tools, Supplies, and Facilities:

Writing surface
PowerPoint Projector
PowerPoint Slides
Transparency Masters
Copies of Lab Sheets for students

Terms: The following terms are presented in this lesson (shown in bold italics and on PowerPoint Slides 2 and 3):

- Ametamorphic
- Antennae
- Antibiosis control
- Beneficial insect
- Biological control
- Chemical control
- Chitin
- Clean culture
- Complete metamorphosis
- Cultural control
- Economic threshold
- Eradication
- Exoskeleton
- External feeding insects
- Genetic control
- Harmful insect
- Incomplete metamorphosis
- Insect
- Internal feeding insects
- Larva
- Mechanical control
- Metamorphosis
- Nonpreference control
- Pesticide resistance
- Pest resurgence
- Pupa
- Quarantine
- Regulatory control
- Scouting
- Subterranean insects

- Targeted pest
- Threshold
- Tolerance control
- Trap crop
- Viviparous

Interest Approach: Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Display to the students different examples of insects. Ask them to identify any differences they observe. Lead a class discussion that will introduce the lesson.

Summary of Content and Teaching Strategies

Objective 1: Describe the biology of insects.

(PowerPoint Slide 4)

I. Knowing insect biology helps explain why insects damage plants or perform beneficial services. Basic insect biology helps in selecting control methods.

A. Insects are in the class *Insecta* and have several characteristics.

1. Each has an ***exoskeleton***, made of chitin, which is the body wall of the insect. It provides protection and support for the insect. Muscles and organs are attached to the inside wall of the strong chitin. The ***chitin*** gives shape to the body and protects the organs.
2. The number of segments in the exoskeleton varies but is about 20 in most insects.
3. Some segments are easy to see, while others are fused tightly together and difficult to see.

(PowerPoint Slide 5)

B. These segments form the three major body sections: head, thorax, and abdomen.

1. The head contains the brain, mouthparts, and most of the sensory organs, eyes, and antennae. The ***antennae*** are segmented appendages that act as sensory organs.

(PowerPoint Slide 6)

The mouthparts of insects tend to be one of two types: chewing and sucking. A chewing insect bites off, chews, and swallows plant parts. Holes in leaves, buds, flowers, or other plant parts indicate the damage was done by a chewing insect. A sucking insect pierces the outer layer of a plant and sucks sap from it. The insect makes a tiny hole and uses the plant juice as its food.

2. The thorax provides locomotion and has wings and pairs of legs attached to it. The abdomen contains organs for food digestion, respiratory, reproduction, and excretion.

(PowerPoint Slide 7)

C. Most insects reproduce sexually but differ in their development from the young to the adult stage. Insects go through stages of development known as ***metamorphosis***. The changes are distinct as they go from egg to adult.

(PowerPoint Slide 8)

1. ***Incomplete metamorphosis*** has three stages of development: egg, nymph, and adult. Eggs hatch into nymphs, which are immature forms that resemble the adult. Nymphs usually molt, and lose and regrow their exoskeleton several times before reaching adult stage.

(PowerPoint Slide 9)

2. ***Complete metamorphosis*** has four stages of development: egg, larvae, pupa, and adult. ***Larva*** are segmented, wormlike forms that often inflict considerable damage on plants. After an active larva stage, a pupa is formed. The ***pupa*** is a resting stage before it becomes an adult. Most pupae are surrounded by a cocoon or protective case.

(PowerPoint Slide 10)

D. Some insects are ***ametamorphic*** (without metamorphosis). The insect hatches from the egg as a very small replica of the full-grown adult. Ametamorphic insects can also be ***viviparous***, giving birth to live young with no egg stage; and parthenogenic, reproducing asexually.

****Use TM: G4-1 and G4-2 as visual material for lecture and discussion.**
PowerPoint Slide 11 can also be used to illustrate the major parts of an insect.

Objective 2: Explain the classification of insects.

(PowerPoint Slide 12)

II. An ***insect*** is a small boneless animal whose body is divided into three sections. Insects are classified in many ways.

(PowerPoint Slide 13)

A. Scientific classification of insects.

1. The Arthropoda phylum includes animals with exoskeletons and segmented bodies. The phylum is further divided into classes, with insects being in the Insecta class. The class has several orders, with each of these having families, genus and species.
2. The genus and species form the scientific names of insects. These divisions within the Insecta class are based on similarities and differences among the animals.

(PowerPoint Slide 14)

B. Benefit classification of insects.

1. A ***beneficial insect*** is one that is of value for the role it fills in the environment. These insects perform activities that help humans in providing for their needs.
2. Valuable activities such as: predators or parasites of other insects, destroy various weeds, produce commercial products, plant pollinators, food for

man and animals, medicinal purposes, scavengers that eat decaying organic matter, and aesthetic value.

(PowerPoint Slide 15)

3. A ***harmful insect*** is one that causes damage to plants, animals, or property. It injures or destroys what it attacks.
4. Harmful insects damage food, feed crops, and ornamentals, attack man and his domestic animals, attack stored products, transmit disease, and are a nuisance.

(PowerPoint Slide 16)

C. Insects can be classified according to mouthparts. The kind of mouthpart determines how an insect feeds. Control measures can be selected based on the way they feed.

1. Insects are classified on the basis of feeding, such as chewing or sucking.
2. Insects are classified by the kind of metamorphosis they have. The stage of development of an insect is important in assessing the damage they cause plants. The stages also influence the methods used to manage insect pests and control the damage they cause.

(PowerPoint Slide 17)

D. Insects can be classified by where they feed on plants.

1. ***External feeding insects*** chew or suck from the exterior of the plant. They feed on the leaves, stems, buds, or fruit.
2. ***Internal feeding insects*** are of the chewing type that make an opening in the plant and go inside. They feed internally on plant tissues. The damage may not be evident for several days or longer.
3. ***Subterranean insects*** are species in the soil that attack the roots of plants. In some cases, they may attack root-type structures.
4. Both chewing and sucking insects may be involved. The damage is not readily apparent.

****Ask the students if they know any beneficial or harmful insects in your area. Have them describe how they are with beneficial or harmful. If you have samples of these types of insects it would be beneficial to pass them around the classroom as you are talking about them. You could then show the students the mouthparts.**

Objective 3: Classify nematodes and describe their biology.

(PowerPoint Slide 18)

III. Insects and nematodes are similar in that they are small animals and can damage plants.

A. Insects and nematodes are in different phyla in the Animal Kingdom. Nematodes are members of the Nematoda phylum.

1. Many plant pest nematodes are so small that they can only be seen with a microscope.

2. Nematodes that cause damage live in the soil, though some are on leaves, stems, and buds. Species that attack aboveground plant parts are known as foliar nematodes.
3. Nematodes damage plants by piercing and sucking juice or tunneling inside the roots. They secrete a substance that injures roots, allowing bacteria and fungi to enter, which can cause disease.
4. Nematodes have a complete reproductive cycle. Some species bear young, while others lay eggs. Most reproduce sexually, though some reproduce asexually. Plant residue, roots, and the soil protect eggs and larvae through the winter months. After hatching, the nymphs go through four molts before reaching the adult stage. Adults have a sharp spear that punctures plant cells.

Objective 4: Describe methods of insect and nematode management.

(PowerPoint Slide 19)

IV. Preventing damage by insects and nematodes requires good information.

A. The presence of insects alone does not provide enough information.

1. Selecting and using the correct method of insect and nematode management is important. Management measures are expensive and have other effects, such as killing beneficial insects. Proper identification of the pest is essential. Measures are based on the species and the way it feeds. Select a method that is appropriate.
2. Damage by pest should be at a level that merits action. Minor damage may not justify using pesticides. Some methods of pest management can be dangerous to people, other living organisms, and the environment.

(PowerPoint Slide 20)

B. Two methods are used in determining if and when to take action against insect pests.

1. ***Scouting*** is the process of visually inspecting for the presence of insect pests and damage. Look at plants closely for evidence of damage or for the eggs of pests; open leaf folds and areas around buds. Use sweep nets or traps to collect samples of insects. Finding a number of insects or visual evidence of damage may mean the population is high.
2. ***Threshold*** is the density of the pest population that will justify using pest management measures. ***Economic threshold*** is the balance of cost with returns. Minor damage or a low population density does not usually justify spending money on management.

(PowerPoint Slide 21)

C. Many different methods can be used to manage insects and nematodes.

1. ***Biological control*** is the use of living organisms to reduce pest populations. These beneficial organisms are natural enemies of pests. They attach, live in, or infect their pest hosts. Parasites, predators, and pathogens are all used as biological controls.
2. ***Chemical control*** is the use of pesticides to reduce pest populations. ***Pesticide resistance*** is the ability of an organism to tolerate a lethal level

of a pesticide. ***Pest resurgence*** refers to a pest's ability to repopulate after control measures have been eliminated or reduced.

(PowerPoint Slide 22)

3. ***Cultural control*** is used to make the crop environment unsuitable for pests to feed, live, or reproduce, and to improve the health of the crop. Examples of cultural controls include soil tillage, crop rotation, adjustment of harvest or planting dates, irrigation schemes, variety selection, clean culture, and trap crops.
4. ***Clean culture*** refers to any practice that removes breeding or over-wintering sites of a pest. A ***trap crop*** is a susceptible crop planted to attract a pest to a localized area, where the trap crop is either destroyed or treated with a pesticide.

(PowerPoint Slide 23)

5. ***Mechanical control*** is used to physically remove or exclude pests. It includes hand destruction as well as the use of screens to keep out insects, and traps to catch them.
6. ***Genetic control*** of plant pests involves the use of a genetically modified organism (GMO). Plant breeders are constantly working to develop varieties and hybrids that are resistant to, or tolerant of, pest feeding. The biggest advantage of genetic control is that the development of resistant varieties and hybrids is a more stable method since genetic resistance lasts for several years. Other types of control need to be repeated each year.

(PowerPoint Slide 24)

D. Genetic control of insects and mites can be divided into three groups.

1. ***Nonpreference control*** allows plant breeders to alter the plant's biochemistry or constituents so that a particular variety or hybrid is less palatable to the pest. If the taste, aroma, color, or texture of the crop plant is undesirable to the pests they move to a different variety or a different host plant such as another crop or a weed.
2. With ***antibiosis control***, the crop plant components have a harmful effect on the growth or reproduction of the pest when it feeds on it.
3. ***Tolerance control*** allows the host plant not to suffer economic damage even though it may be heavily infested with the pest.

(PowerPoint Slide 25)

4. In some parts of the world governments have created laws that prevent the entry or spread of known pests into uninfested areas, this is referred to as ***regulatory control***. Regulatory agencies also attempt to contain or eradicate certain types of pest infestations.
5. A ***quarantine*** is the isolation of pest-infested material. A ***targeted pest*** is a pest that, if introduced, poses a major economic threat. If a targeted pest becomes established, an eradication program will be started.
6. ***Eradication*** means total removal or destruction of a pest. This type of pest control is extremely difficult and expensive to administer.

****PowerPoint Slide 26 shows some common insects in parts of the world. Ask the students what type of insects are found in your area. You might have some common insects that are on this PowerPoint Slide. You can also ask them how they manage the amount and type of insects in their field crops. Have students complete LS: G4-1. When they are finished, review the answers as a class in order to strengthen the understanding of the concepts.**

Review/Summary: Use the student learning objectives as a guide to summarizing the lesson. Have students explain terms, processes outlined in the lesson, and the content associated with each objective. Student responses can be used in determining which objectives require greater review or whether further instruction is necessary. Questions on PowerPoint Slide 27 can also be used.

Application: Use TM: G4-1 and TM: G4-2 and/or real insects to have students explain the major parts of an insect and the impact specific body parts and developmental stages have on the growing of agricultural crops.

Evaluation: Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching
1 = e, 2 = b, 3 = g, 4 = i, 5 = d, 6 = f, 7 = h, 8 = k, 9 = l, 10 = a, 11 = j, 12 = c

Part Two: Completion
1. Pest resurgence
2. External feeding
3. genetically modified
4. beneficial
5. Scouting
6. antennae

Part Three: Short Answer
Incomplete metamorphosis has three stages of development: egg, nymph, and adult. Complete metamorphosis has four stages of development: egg, larvae, pupa, and adult.

Sample Test Name_____

Test

Unit G Lesson 4: Managing Insects

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

a. Biological control	e. Insect	i. Metamorphosis
b. Chemical control	f. Internal feeding insect	j. Pesticide resistance
c. Cultural control	g. Larva	k. Subterranean insects
d. Harmful insect	h. Mechanical control	l. Threshold

_____ 1. Small boneless animal whose body is divided into three sections.

_____ 2. The use of pesticides to reduce pest populations.

_____ 3. Segmented, wormlike forms that often inflict considerable damage on plants.

_____ 4. Insects go through stages of development.

_____ 5. Insect that causes damage to plants, animals or property.

_____ 6. Insects of the chewing type that make an opening in the plant and go inside.

_____ 7. Used to physically remove or exclude pests.

_____ 8. Species in the soil that attack the roots of plants.

_____ 9. The density of the pest population that will justify using pest management measures.

_____ 10. The use of living organisms to reduce pest populations.

_____ 11. The ability of an organism to tolerate a lethal level of a pesticide.

_____ 12. Used to make the crop environment unsuitable for pest to feed, live or reproduce, and to improve the health of the crop.

Part Two: Completion
Instructions. Provide the word or words to complete the following statements.

1. _____ _____ refers to a pest's ability to repopulate after control measures have been eliminated or reduced.

2. _____ _____ insects chew or suck form the exterior of the plant. They feed on the leaves, stems, buds, or fruit.

3. Genetic control of plant pests involves the use of a _____ _____ organism.

4. A _____ insect is one that is of value for the role it fills in the environment.

5. _____ is the process of visually inspecting for the presence of insect pests and damage.

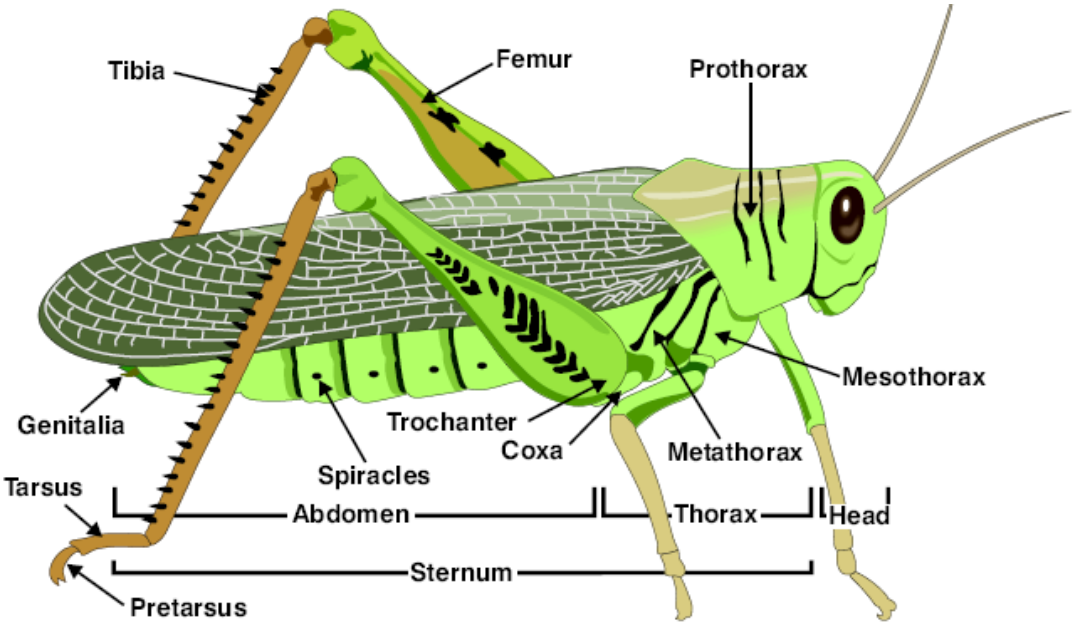
6. The _____ are segmented appendages that act as sensory organs.

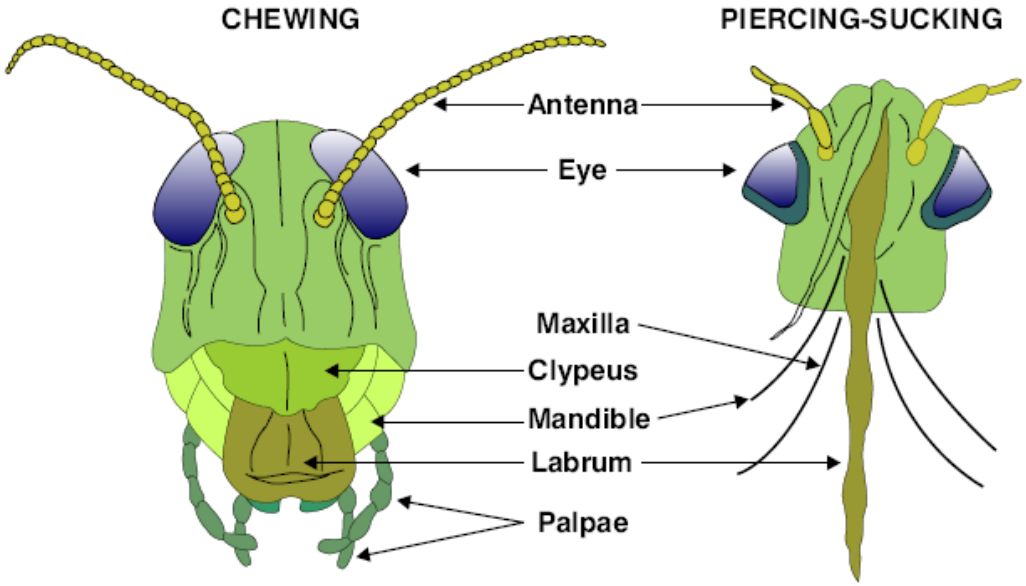
Part Three: Short Answer
Instructions. Provide information to answer the following question.

What is the difference between incomplete and complete metamorphosis?

TM: G4-1

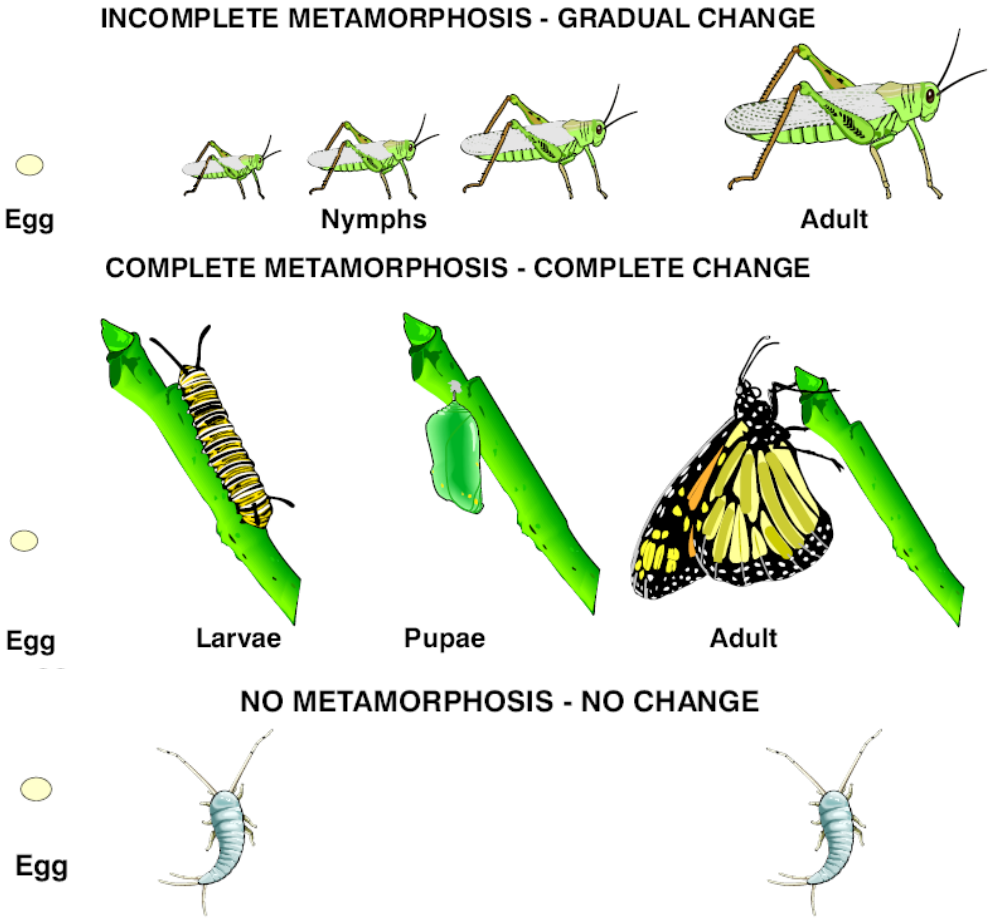
MAJOR PARTS OF AN INSECT





TM: G4-2

METAMORPHOSIS



LS: G4-1 Name_____

Lab Sheet

Insect Identification

Materials:
Clip board, paper, pencil, and crop scouting guide or class notes, field or insect samples

Procedure:
Using given the specimens, determine the type of insect present. Describe all your steps in determining the insect.

Sample #1

Sample #2

Sample #3

Sample #4