

Course	Agricultural Science II
Unit	Entomology
Lesson	Introduction to Entomology
Estimated Time	Two 50-minute blocks

Student Outcome

Discuss the significance of entomology.



Learning Objectives

1. Define entomology.
2. Describe why entomology is important.
3. Define the role of insects in society.
4. Identify the educational requirements of some careers in entomology.
5. Identify some career areas enhanced by a working knowledge of entomology.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Handout
 -  HO 1 – Facts About Insects
2. Activity Sheet
 -  AS 1 – Interview
3. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
4. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites
 - Smithsonian National Museum of Natural History, Department of Entomology. Accessed November 13, 2007, from <http://entomology.si.edu/>.
 - Bugbios. Dexter Sear at I/O Vision. Accessed November 13, 2007, from <http://www.insects.org/>.

Interest Approach

Distribute HO 1, a list of “fun facts” about insects and entomology. Discuss how entomology affects our lives. To help students relate insects to their lives, ask questions such as “Why is food cooked?” or “Why is food stored at certain temperatures?”


Break down a common product into its basic components. Point out the different careers involved in the production of the product. Also point out how entomology is involved in those careers.


Communicate the Learning Objectives

1. Define entomology.
2. Describe why entomology is important.
3. Define the role of insects in society.
4. Identify the educational requirements of some careers in entomology.
5. Identify some career areas enhanced by a working knowledge of entomology.

Instructor Directions	Content Outline
Objective 1 <i>Discuss with students what entomology is. Explain that insects are small, six-legged animals. Emphasize the extensive insect activities in the world and in our lives.</i>	Define entomology. Entomology is the study of insects. The study of insects includes their development, anatomy, physiology, life history, behavior, environment, and classification.
Objective 2 <i>Discuss why entomology is important. Point out that insects can have a positive or negative effect on plants, people, and the environment.</i>	Describe why entomology is important. <ol style="list-style-type: none">1. Insects are the most numerous animals in the world.2. They have an enormous impact on people’s lives.3. Entomology gives people a better understanding of the environment, biology, and the world in which they live.4. Entomology can be used to help reduce the extensive economic losses in damage caused by insects each year.5. Entomology helps improve human and animal health.
Objective 3 <i>Discuss how insects are involved in different industries. Encourage students to think of ways in which insects are beneficial and harmful.</i>	Define the role of insects in society. <ol style="list-style-type: none">1. Agriculture<ol style="list-style-type: none">a. Agriculture is a major industry in the U.S. and the world.

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> b. Insects play an important part in the food chain by providing food for other animals. c. Some insects destroy other insects that are considered harmful. d. Insects pollinate crops. e. Insects damage or destroy crops, food and fiber products, and wood. f. Insects provide food (honey from the honey bee) and fiber (silk from the silk worm). <ol style="list-style-type: none"> 2. Environmental sciences – the study of the forces and conditions that surround and influence living and nonliving things; includes any studies in ecology <ul style="list-style-type: none"> a. Insects break down organic and nonorganic materials in the environment. Insects are nature’s own recycling program. 3. Medicine <ul style="list-style-type: none"> a. Insects transmit diseases to humans, animals, and plants. b. Insects are used extensively in many kinds of research because of their small size and rapid reproduction. 4. Construction <ul style="list-style-type: none"> a. Knowledge about insects is used when selecting the type of construction material. b. Insects, such as termites, can cause damage to wooden structures. 5. Product development – insects used in the research and development of products such as cosmetics, cleaning materials, food preservatives, and medicines
<p>Objective 4</p> <p><i>Discuss how studying insects can lead to many different career choices. Entomologists are scientists who specialize in the study of insects. A wide variety of careers are available. These careers require different levels of education and training. Entomologists can be grouped by their area of specialization, and these areas often overlap. Have</i></p>	<p>Identify the educational requirements of some careers in entomology.</p> <ol style="list-style-type: none"> 1. Agricultural entomologists <ul style="list-style-type: none"> a. Study insects that affect the production of foods and fibers b. Work in all industries in agriculture c. Educational requirements vary from some training in entomology to a doctoral degree in entomology. d. Examples of careers in this area include: crop scout, agricultural product dealer, insecticide applicator, researcher, forester, greenhouse manager, pest controller.

Instructor Directions	Content Outline
<p><i>students interview someone who uses entomology directly or indirectly in his or her work. Students should use AS 1 as an outline when conducting the interview.</i></p> <p> AS 1 – Interview</p>	<ol style="list-style-type: none"> 2. Entomology instructors <ol style="list-style-type: none"> a. Teach entomology at different levels (high school, junior college, and university) b. Educational requirements will vary depending on job 3. Medical and veterinary entomologists <ol style="list-style-type: none"> a. Are concerned with insects that influence the health of people and animals in any way b. Develop insecticides to protect crops and reduce diseases c. Many jobs require a graduate degree in the area of medical specialization with additional training or classes in entomology. Some jobs may only require a 2-year degree. d. Include doctors, assistants, and technicians 4. Industrial entomologists <ol style="list-style-type: none"> a. Involves the research and manufacture of many types of products for industrial and domestic use b. Work in many product development laboratories c. Some jobs require only a high school diploma and some technical training, while other jobs require additional training 5. Ecological entomologists <ol style="list-style-type: none"> a. Concerned with protecting and sustaining the environment and health standards b. Regulate proper waste treatment and chemical disposal c. Usually a bachelor’s degree or higher is necessary
<p>Objective 5</p> <p><i>Discuss with students how a general knowledge of insects and insect behavior can be useful in many job areas. Many times a minor emphasis in entomology is an excellent combination with another major field.</i></p>	<p>Identify some career areas enhanced by a working knowledge of entomology.</p> <ol style="list-style-type: none"> 1. Landscaping and turf management <ol style="list-style-type: none"> a. Turf management involves the care and maintenance of landscaped areas. b. This field is very diverse depending at what level and how you want to work. c. Entomology is an excellent minor in this area. d. Pesticide applicator’s certification may be necessary. 2. Animal and human medical care <ol style="list-style-type: none"> a. Assistants and technicians in all areas need some training in insect management.

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> b. There are many openings at lower levels in these areas. 3. Food science <ul style="list-style-type: none"> a. Food production is a very large area in which insect control is necessary at all levels. b. An important part of food production is the preservation and the transportation of food items throughout the U.S. and the world. 4. Biological science - There are many areas in the biological and natural sciences that are enhanced by the study of insects.
<p>Application</p> <p> AS 1 - Interview</p>	<p>Answers to AS 1: The instructor will need to evaluate this activity sheet.</p> <p>Other activities:</p> <ul style="list-style-type: none"> 1. Have students list all the different products they find that contain insecticides. They can check their homes, local grocery stores, and garden supply stores for items. 2. Students can talk with people who work with the environment and get their opinion on insects and insect control. 3. Invite someone who uses entomology in his or her work to be a guest speaker. A greenhouse manager and a landscaper are two examples.
<p>Closure/Summary</p>	<p>Entomologists study insects. They study their development, anatomy, physiology, life history, behavior, environment, and classification. The study of entomology is necessary in many aspects of society.</p>
<p>Evaluation: Quiz</p>	<p>Answers:</p> <ul style="list-style-type: none"> 1. The study of insects 2. A scientist who specializes in the study of insects 3. Harmful insects are those that cause damage to food and fiber crops and transmit diseases. Beneficial insects destroy the harmful insects, provide food and fiber products, and enhance the environment. 4. Any four of the following: agricultural entomologists, entomology instructors, industrial entomologists, ecological entomologists, or medical and veterinary entomologists

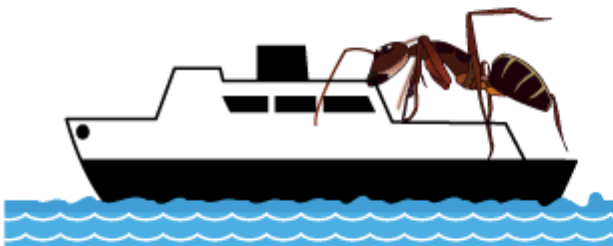
Instructor Directions	Content Outline
	5. b 6. c 7. d 8. d

Facts About Insects

Of all the species of living things in the world, most are insects (about 80 percent).



One female aphid can leave 10^{108} descendants in the course of a season.



Insects live in almost every place in the world. The only habitat that insects have not invaded to any great extent is the ocean.

Insects can cause much damage. Annual losses caused by insects in the United States have been estimated to be about \$3-1/2 billion.



Insects are very beneficial to man in many ways. The value of insects pollinating fruits and vegetables alone is estimated to be about \$4-1/2 billion each year in this country.

Interview

Directions: Interview a person with a career in entomology. Record his or her name, occupation, and place of employment. The questions can be used as an aid when interviewing the individual.

Name: _____

Occupation: _____

Place of Employment: _____

How long have you worked in your present occupation?

How did you decide on this job?

What training was necessary for this job?

What professional skills do you use in this job?

What jobs have you had previously that helped prepare you for this job?

What other jobs have you considered?

What are your job/career plans for the future?

How did you get interested in entomology?

What advice would you give someone who is considering a career in entomology?

Comments:

Unit: Entomology

Name _____

Lesson 1: Introduction to Entomology

Date _____

Evaluation

Directions: Complete the following with a short answer.

1. What is entomology?

2. What is an entomologist?

3. What are the differences between harmful and beneficial insects?

4. What are four careers in entomology?

- a. _____
- b. _____
- c. _____
- d. _____

Directions: Circle the letter that corresponds to the best answer.

5. Construction workers may use their knowledge of entomology for controlling which of the following insects?

- a. Ants
- b. Termites
- c. Roaches
- d. Flies

6. Some insects are considered harmful because they
 - a. Pollinate plants
 - b. Provide food and fiber
 - c. Destroy helpful insects
 - d. Break down materials in the environment

7. Some insects are considered helpful because they
 - a. Transmit diseases
 - b. Destroy food and fiber
 - c. Eat wooden structures
 - d. Promote drug research

8. Knowledge of insects is useful in which of the following medical areas?
 - a. Treatment of diseases
 - b. Research
 - c. Veterinary science
 - d. All of the above

Course	Agricultural Science II
Unit	Entomology
Lesson	Insect Collection
Estimated Time	Four 50-minute blocks

Student Outcome

Prepare an insect collection.





Learning Objectives

1. Describe how insects are collected.
2. Describe how insects are preserved.
3. Describe how insects are labeled.
4. Describe how insects are pinned.
5. Determine how the wings of butterflies and moths are spread.
6. Describe how insect collections are arranged.

Grade Level Expectations

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - PPt 1 - Location of Insects
 - PPt 2 - Killing Jar
 - PPt 3 - Mounted Insect and Label Placement
 - PPt 4 - Pin Placement for Different Insects
 - PPt 5 - Pinning Blocks
 - PPt 6 - Spreading Board
 - PPt 7 - Spreading an Insect
2. Activity Sheets
 -  AS 1 - Making a Killing Jar
 -  AS 2 - Labeling Insects
 -  AS 3 - Spreading the Wings of Butterflies and Moths
 -  AS 4 - Making an Insect Collection
3. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
4. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- A pre-made or commercial insect collection or pictures
- A piece of wood damaged by termites, grain or flour damaged by weevils, bees or flies in a jar or an ant farm, or pictures of damage or diseases caused by or carried by insects
- Samples of insect pins, preservation jars filled with alcohol, or envelopes
- Rubber insect or a real one to demonstrate pinning
- See AS 1 through AS 4 for materials and equipment needed to complete the activity sheets.

Supplemental Information

1. Internet Sites

- Collecting Insects. Department of Entomology, University of Nebraska-Lincoln. Accessed June 10, 2008, from <http://entomology.unl.edu/tmh/ent115/labs/collecting.htm>.
- Insects and Diseases Publications. University of Missouri Extension. Accessed June 10, 2008, from <http://extension.missouri.edu/explore/agguides/pests/>.

Interest Approach



Ask students where they think insects can be found: homes, lawn, garden, woods, water, and urban areas. Using PPT 1, Location of Insects, ask students to name insects they could find in the given areas in the picture. Examples include: tomato worms and corn bores in garden, grubs in lawn and garden, fleas on the dog, and mosquitoes in water.

Have a pre-made or commercial insect collection displayed as an example. If this isn't possible, examples of collections can be illustrated through pictures.

Display visual aids such as: a piece of wood damaged by termites; grain or flour damaged by weevils; bees or flies in a jar or an ant farm; or pictures of damage or diseases caused by or carried by insects.

Communicate the Learning Objectives

1. Describe how insects are collected.
2. Describe how insects are preserved.
3. Describe how insects are labeled.
4. Describe how insects are pinned.
5. Determine how the wings of butterflies and moths are spread.
6. Describe how insect collections are arranged.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Discuss with students the different places where insects can be found. Remind students that many people are afraid of insects. Stress that most insects are not dangerous. Tell them that it is very common to be apprehensive about insects until you become more familiar with them and the ways to handle them. Use PPT 2 to illustrate a killing jar. Have students make a killing jar using AS 1.</i></p> <p> PPT 2 – Killing Jar</p> <p> AS 1 – Making a Killing Jar</p>	<p>Describe how insects are collected.</p> <ol style="list-style-type: none">1. Prepare a killing jar2. Locate insects3. Catch insects<ol style="list-style-type: none">a. Bare handsb. A netc. Boxes, jars, or envelopes4. Place insects in a killing jar

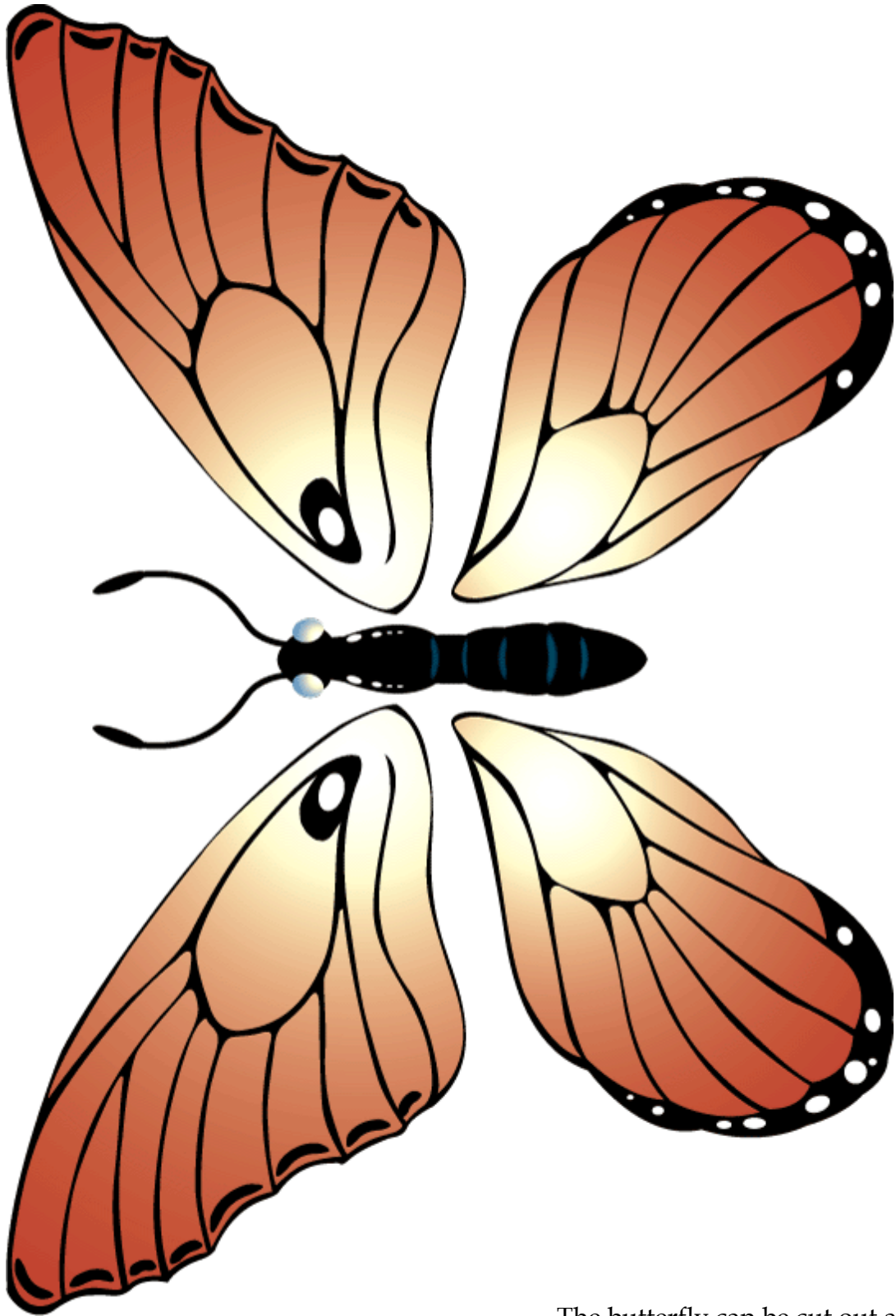
Instructor Directions	Content Outline
<p>Objective 2</p> <p><i>Discuss the procedures for preserving insects. Samples of insect pins, preservation jars filled with alcohol, or envelopes can be used as visual aids.</i></p>	<p>Describe how insects are preserved.</p> <ol style="list-style-type: none"> 1. Pinning – This is the most common method used for most insects. 2. Liquid – Liquid is used for soft-bodied insects that shrivel when dried. 3. Envelopes – Envelopes can be used for slender and fragile insects such as dragonflies.
<p>Objective 3</p> <p><i>Discuss the procedures for labeling insects. Point out what information must appear on the labels and what information is extra. Refer to PPT 3. Have students complete AS 2.</i></p> <p>☐ PPT 3 – Mounted Insect and Label Placement</p> <p>📄 AS 2 – Labeling Insects</p>	<p>Describe how insects are labeled.</p> <ol style="list-style-type: none"> 1. Locality and ecological labels – made of stiff white paper about 1/4 by 3/4 inches <ol style="list-style-type: none"> a. All insects collected must have a locality label that contains the date and place where the insect was caught. The name of the collector may be included on the locality label. b. Information about the insect’s environment and habitat may be on a second label called an ecological label. c. Labels and insects are mounted on the pin at the correct heights <ul style="list-style-type: none"> - Insect – 1-inch mark - Locality label – 5/8-inch mark - Ecological label – 3/8-inch mark d. They should be positioned parallel with the body of the insect or point e. Labels can be read from either the right or left so long as all labels are read in the same direction. 2. Identification labels – 1 square inch in size <ol style="list-style-type: none"> a. Are placed directly in an insect collection b. Identify groups of insects by order or identify each specimen when insects are arranged and labeled by species c. Are placed alongside a group or at the base of an individual insect pin d. Contain the order of the group of insects or the scientific name of the insect, the name of the collector, and the date of capture 3. Slide label – used for insects mounted on sides.

Instructor Directions	Content Outline
<p>Objective 4</p> <p><i>Discuss the procedures for pinning insects. Pinning is a way to mount and preserve insects indefinitely. The actual pinning of an insect can be demonstrated for the students. A rubber insect can be used and re-used, if a real one is not desired. Students might practice some pinning in class. Refer to PPT 4 for pin placement and PPT 5 for pinning blocks. PPT 3 can be used to point out insect and label placement on pins.</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> PPT 3 – Mounted Insect and Label Placement <input type="checkbox"/> PPT 4 – Pin Placement for Different Insects <input type="checkbox"/> PPT 5 – Pinning Blocks 	<p>Describe how insects are pinned.</p> <ol style="list-style-type: none"> 1. Pinning should be done as soon as insects are collected. 2. The insect is held between the thumb and forefinger of one hand while the pin is inserted with the other hand. 3. Insects are pinned in particular places depending on the type of insect. 4. Insects and labels are mounted on the pin at certain heights: 1, 5/8, and 3/8 inches. A pinning block can be used to make mounting easier. 5. Small insects are mounted on a point. <ol style="list-style-type: none"> a. Points are small, triangular pieces of cardboard mounted on the pin. b. The insect is glued to the extended point of the triangle. c. Insects are attached with glue or household cement.
<p>Objective 5</p> <p><i>Discuss the procedures for spreading the wings of butterflies and moths. To illustrate the spreading technique, use the butterfly provided at the end of this lesson to make a model out of stiff paper or cardboard. The paper wings can be spread into the proper positions as the students watch. Students can practice with the model later. The use of a spreading board can be demonstrated if one is available. Refer to PPT 6 and PPT 7. Have students complete AS 3.</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> PPT 6 – Spreading Board <input type="checkbox"/> PPT 7 – Spreading an Insect 	<p>Determine how the wings of butterflies and moths are spread.</p> <p>The steps for spreading the wings of a butterfly or moth on a spreading board are given below. If a spreading board is not available, turn the insect upside-down to spread the wings on a flat surface.</p> <ol style="list-style-type: none"> 1. Hold the specimen by grasping it by the thorax, the middle section of the insect. Holding it right side up, insert a pin through the middle of the thorax. Move it to the 1-inch position on the pin. The pinned specimen is then lowered onto the spreading board. The pin should go into, and maybe even through, the bottom of the groove. Push the pin through the board until the underside of the wings is even with the top piece of the spreading board. Pin narrow strips of paper over the wings on each side. 2. Remove the pin on one side at the lower end of the strip of paper. Raise the front wing until the rear edge is at a right angle to the body. Forceps, a pin, or some

Instructor Directions	Content Outline
<p>AS 3 – Spreading the Wings of Butterflies and Moths</p>	<p>other tool may be helpful in doing this. Be careful not to tear or puncture the wing. When the wing is in place, insert a pin through the strip of paper just in front of the tip of the wing. Pin the lower edge of the paper strip back into place.</p> <ol style="list-style-type: none"> 3. Repeat this procedure with the other front wing. 4. Use forceps, a pin, or some other tool to raise the hind wing on one side until the space between the two wings is reduced. The front and hind wings of these insects will overlap at the base with the front edge of the hind wing under the rear edge of the front wing. Move the pin in the lower part of the paper strip until it is just below the tip of the hind wing. 5. Repeat this procedure with the hind wing on the other side. 6. Now, position the antennae so that they appear balanced. Put pins alongside the antennae to hold them in place. 7. Fasten the legs close to the body at right angles to the body. This is done by placing a strip of paper across the entire body. 8. The insect is left in position until it is dry. This will depend on the size of the insect, the temperature, and the humidity.
<p>Objective 6</p> <p><i>Discuss the procedures for arranging insect collections. An insect collection that is already made can be displayed for the students, if one is available. Have students complete AS 4.</i></p> <p>AS 4 – Making an Insect Collection</p>	<p>Describe how insect collections are arranged.</p> <p>There is no exact way to organize an insect collection. The way the insects are arranged will depend on the size of the collection, the types of insects collected, and the preference of the individual. However it is done, the collection should be neat and orderly and the insects easily seen. Insect collections are arranged in display boxes for study and storage. There are several kinds of display containers.</p> <ol style="list-style-type: none"> 1. Mounting <ol style="list-style-type: none"> a. The most common type used. b. Made of wood or heavy cardboard. c. Measure about 9 x 12 x 3 inches and have a tight-fitting lid. d. The bottom is lined with a soft and sturdy material (usually sheet cork, balsa wood, Styrofoam, or corrugated cardboard).

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Riker mount <ol style="list-style-type: none"> a. A box with a single glass top. b. Filled with cotton. c. Insects are seen easily. d. Mounts can be handled without damaging the specimens e. Only one side of the insect can be seen. f. Some insects tend to fade after extended exposure to the light. 3. Glass mounts <ol style="list-style-type: none"> a. A box with glass sides on the top and the bottom. b. Similar in material and size to the Riker mount. c. Contains no cotton. d. Both sides of the insect can be seen. e. Each glass mount contains only a few insects. 4. Plastic mounts <ol style="list-style-type: none"> a. Consist of two sheets of thick plastic. b. The insect in mounted between them. c. The edges are sealed with acetone or tape. d. Another method is to embed insects in a block of plastic. e. The process is very involved but the result is attractive and very durable. 4. Slide mounts <ol style="list-style-type: none"> a. Slide mounts allow insects or parts of insects to be studied in detail. b. Dark-colored samples are treated before mounting in order to be seen better. c. Various chemicals are used on the samples before mounting and viewing. <p>Note: Insect collections may be attacked and damaged by beetles and other pests. Special repellents, which are placed in a small pillbox or on a piece of cloth, should be put in the corner of the display box or underneath the cotton in Riker mounts.</p>
<p>Application</p>	<p>Other activities:</p> <ol style="list-style-type: none"> 1. Have a contest featuring the best insects collected in each of several categories (possibly by class vote). Some suggestions are the biggest, the smallest, the most colorful, the ugliest, the prettiest, the rarest, and the best mounted. These can be exhibited with a

Instructor Directions	Content Outline
	<p>description label as a display for the class or school. Bonus points may be offered.</p> <p>2. A covered terrarium can be set up at the beginning of the unit. It could contain a piece of wood and some termites, an ant farm, or a bee colony. Observe the insects throughout the Entomology course.</p>
Closure/Summary	<p>Insects can be found almost anywhere. Species are best identified by the use of keys or guides. Preparing an insect collection is a good way to study insects and learn about their environment.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. b 2. b 3. d 4. c 5. c 6. a 7. d 8. c 9. A “point” is a small triangular piece of paper used for mounting small insects.

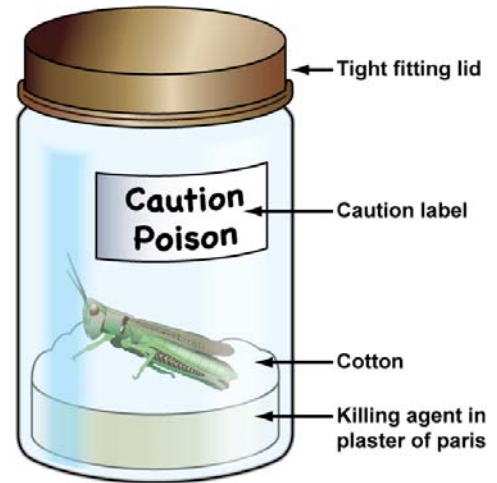


The butterfly can be cut out and used as a model for spreading wings.

Making a Killing Jar

Materials and supplies needed:

1. Wide-mouth jar, 6 to 16 oz. size with a screw-on lid
2. Bowl or container for mixing
3. Plaster of paris
4. Water
5. Ethyl acetate (killing agent)
6. Cotton
7. Tape, masking or electrical
8. Labels



Example of a Killing Jar

Procedure:

1. In a bowl or container, add water to the plaster of paris until a thick mixture is made.
2. Pour the mixture into the jar to a height of about 1 inch (20–30 millimeters).
3. Allow the mixture to air dry at room temperature (this requires several days) or under low heat (light bulb or lowest oven temperature) until completely dry.
4. Pour ethyl acetate onto the plaster of paris to cover it. **Caution: Be careful not to breathe the fumes.**
5. Cover the jar to prevent the fumes from escaping.
6. Let it stand a few minutes so that the plaster of paris can fully absorb the ethyl acetate.
7. Pour off any excess ethyl acetate and replace the lid. There should not be any standing liquid.
8. Place enough cotton to cover the plaster of paris. The insect should not come into direct contact with the plaster of paris.
9. Place tape on the bottom and lower sides of the jar to reduce the chance of breakage.
10. Label the jar "poison."
11. Reapply ethyl acetate to the plaster of paris after several hours of collecting insects as needed. Always leave the lid on unless the collector is actually placing an insect in or removing one from the jar.

Labeling Insects

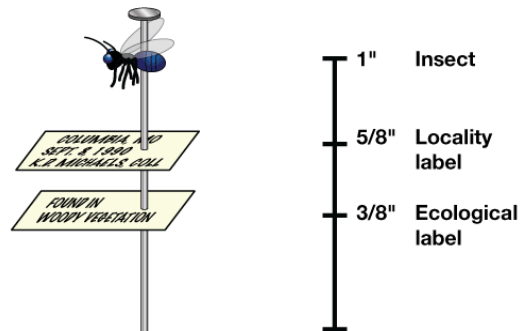
Materials and supplies needed:

1. Stiff white paper
2. Scissors
3. Pen or marker
4. Insect pins
5. Insects (number to be determined by instructor)

Procedure:

1. Cut small pieces of paper, about 1/4 by 3/4 inches or smaller, out of fairly stiff white paper.
2. Prepare the locality label first. Write the date when the insect was found and the place where the insect was found. The name of the collector can also be placed on this label. All information should be written accurately and clearly.
3. On a second label, write any additional information or observations about the insect's environment. This label is called the ecological label.

4. Mount the labels on the pin at the proper height(s) and parallel with the insect (or point). See illustration.



- a. Insect - 1-inch mark
- b. Locality label - 5/8-inch mark
- c. Ecological label - 3/8-inch mark

5. After the specimens are arranged in groups according to order, prepare identification labels.
 - a. Cut out pieces of paper about 1 inch square. You will need one label to identify each specimen.
 - b. Write the scientific name of the insect, the name of the person identifying it, and the month and year when the identification was made on the label.
 - c. Place these identification labels at the base of each specimen.

Note: If the identification labels are used to identify the orders, place a label by each order. This label should contain the name of the order and the collector.

Spreading the Wings of Butterflies and Moths

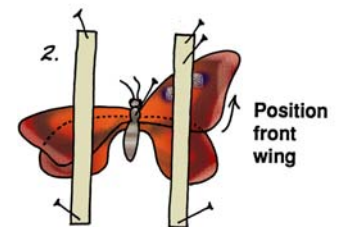
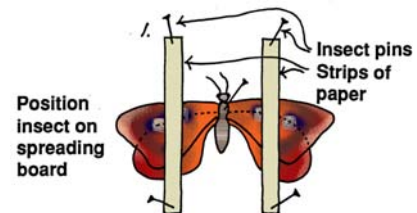
Materials and supplies needed:

1. Winged insect specimen
2. Spreading board
3. Insect pins
4. Narrow strips of paper
5. Forceps, tweezers, or similar tool

Procedure:

NOTE: Always handle the specimen with care so that the parts are not damaged. The following procedure is followed when a spreading board is used.

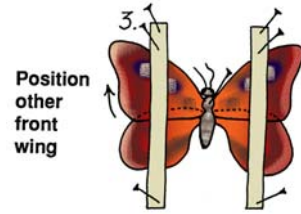
1. Gently grasp the insect specimen by the thorax, the middle section of the insect, and hold it right side up.
2. Insert an insect pin through the center of the thorax.
3. Move the insect to the 1-inch position on the pin.
4. Lower the pinned specimen onto the spreading board. The pin should go into, and maybe even through, the bottom of the groove.
5. Push the pin through the board until the underside of the wings is even with the top piece of the spreading board.
6. Pin narrow strips of paper over the wings on each side to hold them in place. See illustration 1.
7. Remove the pin on one side at the lower end of the strip of paper.
8. Raise the front wing until the rear edge is at a right angle to the body. Forceps, a pin, or some other tool may be helpful in doing this. Be careful not to tear or puncture the wing. See illustration 2.



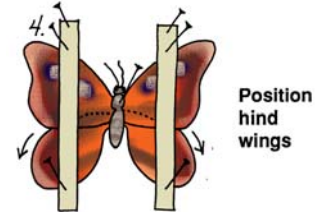
9. When the wing is in place, insert a pin through the strip of paper just in front of the tip of the wing.

10. Pin the lower edge of the paper strip back into place.

11. Repeat this procedure with the other front wing. See illustration 3.



12. Using forceps, a pin, or some other tool, raise the hind wing on one side until the space between the front and hind wings is reduced. The front wing will overlap the hind wing. See illustration 4.

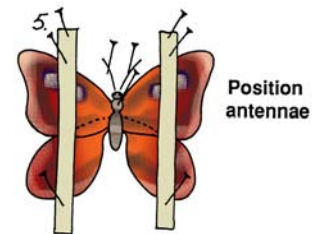


13. Move the pin in the lower part of the paper strip until it is just below the tip of the hind wing.

14. Repeat this procedure with the hind wing on the other side.

15. Position the antennae so that they appear balanced.

16. Put pins alongside the antennae to hold them in place. See illustration 5.



17. Fasten the legs close to the body at right angles to the body by placing a strip of paper across the entire body.

18. Prepare 1 or 2 labels. (Refer to AS 2.)

19. Allow the insect to dry in place. This may take from a few hours to a few days.

20. When the insect is dry, carefully remove the strips of paper and mount the insect with labels.

Making an Insect Collection

Materials and supplies needed:

1. Killing jar
2. Student reference
3. Collection box
4. Insect pins
5. Labels
6. Insects (number to be determined by the instructor)

Procedure:

1. Make a killing jar. (Refer to AS 1.)
2. Locate and catch the insects. (Refer to the Student Reference.)
3. Place the insect in the killing jar as soon as possible.
4. Spread the insect's wings if necessary. (Refer to AS 3.)
5. Pin the insects in the appropriate way and place them so that they rest 1 inch up on the pin. (Refer to the Student Reference.)
6. Prepare the labels. (Refer to AS 2.)
7. Mount the locality label (first label) at the 5/8-inch mark on the insect pin.
8. Mount the ecological label (second label), if there is one, at the 3/8-inch mark on the insect pin.
9. Arrange the mounted insects in a collection box by orders.
10. Add identification labels.

Unit: Entomology

Name _____

Lesson 2: Insect Collection

Date _____

Evaluation

Directions: Circle the letter that corresponds to the best answer.

1. When are insects pinned?
 - a. After drying
 - b. Immediately after they are killed
 - c. Before they are killed
 - d. After they are mounted

2. Which of the following would not be used for preserving insects?
 - a. Envelopes
 - b. Spreading board
 - c. Insect pins
 - d. Liquids

3. Which method should be used to kill insects for a collection?
 - a. Inserting a pin through the thorax
 - b. Using your bare hands
 - c. Spraying them with herbicide
 - d. Using a killing jar

4. Where is the pin inserted for beetles and grasshoppers?
 - a. The scutellum
 - b. The rear edge of the head
 - c. The front part of the right wing
 - d. The abdomen

5. What is the correct height for the first label on a pin?
 - a. 1/2 inch
 - b. 3/5 inch
 - c. 5/8 inch
 - d. 1 inch

6. When the wings of a butterfly are properly spread, which of the following must be true?
 - a. The front and hind wings overlap.
 - b. A spreading board must be used.
 - c. The front and hind wings do not overlap.
 - d. The insect will be in an upside-down position.

7. On the first label, which of the following must be included?
 - a. The date the insect was pinned
 - b. The name of the collector
 - c. How the insect was preserved
 - d. The place the insect was found

8. Which of the following is not contained in an insect collection?
 - a. Preserved insect specimens
 - b. Identification labels
 - c. Killing agent
 - d. Insect pins

Directions: Answer the following short answer question.

9. What is a "point"?

Course	Agricultural Science II
Unit	Entomology
Lesson	Insect Identification
Estimated Time	Two 50-minute blocks

Student Outcome

Describe the procedure for classifying insects to order.

Learning Objectives

1. Identify the distinguishing characteristics of an insect.
2. Identify the three main sections of an insect.
3. Identify the different life stages of insects.
4. Describe how insects are classified.
5. Identify the distinguishing characteristics of insect orders.

Grade Level Expectations




SC/LO/1/E/09-11/a

SC/LO/1/E/09-11/b

SC/EC/3/A/09-11/b

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slides
 - PPt 1 – Three Main Sections of an Insect
 - PPt 2 – Types of Antennae
 - PPt 3 – Types of Mouth Parts
 - PPt 4 – Types of Legs
 - PPt 5 – Examples of Wings
 - PPt 6 – Stages of Development
 - PPt 7 – Incomplete Metamorphosis
 - PPt 8 – Complete Metamorphosis
 - PPt 9 – Insect Classification
2. Handout
 -  HO 1 – Systematic Method to Identify Insect Orders
3. Activity Sheets
 -  AS 1 – Insect Fact Sheet
 -  AS 2 – Insect Orders
4. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
5. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites

- ❑ Insect Identification for the Casual Observer. Accessed December 4, 2007, from <http://www.insectidentification.org/>.
- ❑ Bug Files: Your Bug and Insect Identification Database. Dave's Garden. Accessed December 4, 2007, from <http://davesgarden.com/guides/bf/>.

Interest Approach

Students will begin completing AS 1, Insect Fact Sheet. Explain the purpose of the project to students. Each student is assigned an insect and given a blank Insect Fact Sheet to complete. Emphasize that the fact sheet needs to be kept up on a regular basis. The information compiled throughout the Entomology unit will be used to make their Insect Pest Management Plan in Lesson 7.

Communicate the Learning Objectives

1. Identify the distinguishing characteristics of an insect.
2. Identify the three main sections of an insect.
3. Identify the different life stages of insects.
4. Describe how insects are classified.
5. Identify the distinguishing characteristics of insect orders.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>The students now know where to look for insects, how to collect them, and how to prepare specimens for a collection. The next step is to learn the details of insect bodies, the distinguishing features of each order, and how insects are divided into groups. Discuss the particular features that identify insects and separate them from other animals.</i></p>	<p>Identify the distinguishing characteristics of an insect.</p> <p>An insect is defined as a small animal without a backbone that has the following external characteristics as an adult:</p> <ol style="list-style-type: none">1. A hardened external skeleton2. Three distinct body regions: head, thorax, and abdomen3. One pair of segmented antennae4. Three pairs of segmented legs on the thorax segment5. One pair of compound eyes; some insects have no eyes6. One or two pairs of wings; some adults are wingless
<p>Objective 2</p> <p><i>The best way to study and identify insects is by looking at the three main sections of an insect. Refer to PPt 1 – PPt 5.</i></p> <p><input type="checkbox"/> PPt 1 – Three Main Sections of an Insect</p> <p><input type="checkbox"/> PPt 2 – Types of Antennae</p> <p><input type="checkbox"/> PPt 3 – Types of Mouth Parts</p> <p><input type="checkbox"/> PPt 4 – Types of Legs</p>	<p>Identify the three main sections of an insect.</p> <ol style="list-style-type: none">1. Head – the hardened region at the front of the body including the eyes, antennae, and mouth parts<ol style="list-style-type: none">a. There are two types of eyes.<ul style="list-style-type: none">- Simple eyes: small, located on the top of the head of the adult- Compound eyes: large, located on the head of the adult; made up of a few to several thousand individual eye units, which generally see only light and dark areasb. Insects have one pair of antennae.<ul style="list-style-type: none">- Long, jointed feelers- Grow from the insect’s head- Flexible- Come in a variety of shapes

Instructor Directions	Content Outline
<p><input type="checkbox"/> PPt 5 – Examples of Wings</p>	<ul style="list-style-type: none"> - Function as sensors to detect the odor, sound, taste, and touch of the environment c. There are different types of mouth parts. <ul style="list-style-type: none"> - Chewing - Piercing-sucking - Some insects will have a modification or adaptation of these. 2. Thorax – middle section of an insect’s body <ul style="list-style-type: none"> a. Contains the nerve centers and muscles. b. The wings and legs are attached to the thorax. These come in numerous shapes and patterns depending on the species and function. 3. Abdomen – the section located at the rear of the insect’s body <ul style="list-style-type: none"> a. Visible or hidden under the wings b. Contains the insect’s internal organs (stomach and intestines) c. A place to store and carry food back to the nest d. Sexual organs located here e. Contains glands that secrete fluids for making trails or driving enemies away f. May have a needle-like projection for piercing or stinging
<p>Objective 3</p> <p><i>The development of insects refers to their growth in size and changes in form. There are three stages of development for every insect. Refer to PPt 6 – 8.</i></p> <p><input type="checkbox"/> PPt 6 – Stages of Development</p> <p><input type="checkbox"/> PPt 7 – Incomplete Metamorphosis</p> <p><input type="checkbox"/> PPt 8 – Complete Metamorphosis</p>	<p>Identify the different life stages of insects.</p> <ul style="list-style-type: none"> 1. The embryo stage <ul style="list-style-type: none"> a. Insects begin life as an embryo within an egg. b. The embryo lives on a nutritious yolk. c. Hatching may take days, weeks, or months. 2. The immature stage <ul style="list-style-type: none"> a. After hatching, the insect is called an immature. b. The life of an immature is divided into growth stages called instars. c. Insects progress from one instar to the next by periodically making a new outer layer and shedding the old one. The shedding process is called molting. d. The process continues – instar growth, molting, instar growth, molting, etc. – until the insect becomes an adult. This is called metamorphosis. e. There are two systems of development, or metamorphosis.

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> - Incomplete metamorphosis <ul style="list-style-type: none"> • The immature looks like a small adult. • The immature is called a nymph. • Nymphs eat the same foods as the adults. • Changes in development are mainly an increase in size, wing development, and sexual organs. • Examples include grasshoppers, thrips, stink bugs, leafhoppers, and aphids. - Complete metamorphosis <ul style="list-style-type: none"> • The immature does not look like the adult. • Immatures are called larvae. • Larvae do not eat the same foods as the adults. • There are numerous dramatic changes in development, both on the inside and the outside of the body. • They contain one additional growth stage, the pupa. • Some insects surround themselves with a cocoon. • The insect develops greatly while a pupa. • The insect breaks out of the pupa (and cocoon) when the adult body is fully formed. • Examples include lady beetles, weevils, flies, and moths. <p>3. The adult stage</p> <ol style="list-style-type: none"> a. The insect emerges from the pupa with crumpled wings and a soft body. b. The adult body dries, hardens, and develops color within minutes to hours. c. Depending on the species, adults may live from 1 hour to 20 years. In general though, adults only live a few weeks.
<p>Objective 4</p> <p><i>A system for classifying insects is important to identify each type of insect properly. Refer to PPT 9. HO 1 uses a flow chart system to help in identifying insect orders.</i></p>	<p>Describe how insects are classified.</p> <ol style="list-style-type: none"> 1. All animals, including insects, are classified by characteristics that are similar. The animal kingdom is the most general category. It is divided into groups until the insects that are most alike are classified together. 2. A scientific name is given to each insect.

Instructor Directions	Content Outline
<ul style="list-style-type: none"> ☐ PPt 9 – Insect Classification ☒ HO 1 – Systematic Method to Identify Insect Orders 	<ul style="list-style-type: none"> a. Genus – first part of name, written capitalized b. Species – second part of name, written lower case 3. Field guides or insect keys are references that usually include the following information: <ul style="list-style-type: none"> a. Description of the insect b. Distinguishing features of the order c. How different insects are related to one another d. The lifestyle and environment of the insect
<p>Objective 5</p> <p><i>Discuss the differences in the insect orders and point out what features are used to distinguish each. Since there is not enough time to go through all the orders in detail, give an overview of the orders.</i></p> <p><i>Have students identify the order in which their individual insect belongs and what its characteristics are. The Information can be written on their AS 1. Also have students complete the chart in AS 2.</i></p> <ul style="list-style-type: none"> ☒ AS 1 – Insect Fact Sheet ☒ AS 2 – Insect Orders 	<p>Identify the distinguishing characteristics of insect orders.</p> <p>Note: A brief summary of the distinguishing characteristics of each of the orders is given in the Student Reference. The information is presented in the following order.</p> <ul style="list-style-type: none"> 1. The scientific name of the order 2. What the name means 3. The common name, if there is one 4. The number of species 5. The type of metamorphosis 6. The type of mouth parts 7. A description of the body: wings, eyes, other distinguishing traits or activities <p>Insect wing structure and shape are important in insect identification. The following questions can be used to help students become familiar with the orders.</p> <ul style="list-style-type: none"> 1. Which orders have piercing-sucking mouth parts? 2. Which orders have complete metamorphosis? 3. Which order has a name meaning “long wing”? 4. To which order do roaches belong? 5. Which order is commonly called “beetles”? 6. Which orders have small eyes as a distinguishing feature? 7. Which orders are parasitic? 8. Which order has thick, horny wing covers?
<p>Application</p> <ul style="list-style-type: none"> ☒ AS 1 – Insect Fact Sheet ☒ AS 2 – Insect Orders 	<p>Answers to AS 1: The instructor will need to determine if answers are appropriate.</p> <p>Answers to AS 2: Answers are at the end of this lesson.</p>

Instructor Directions	Content Outline
	<p>Other activities: Divide the students into small groups. Have each group look up the order and characteristics of any selected insects or insects collected so far. Have a contest where the group correctly identifying a selected insect first wins.</p>
Closure/Summary	<p>Insect characteristics commonly used to identify and classify insects are the wings, body shape, mouth parts, and type of metamorphosis. Insect identification can be done in a systematic way using guides or keys.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. c 2. d 3. d 4. a 5. c 6. a 7. c 8. b 9. b 10. a

Answers to AS 2 are in bold:

Insect Orders

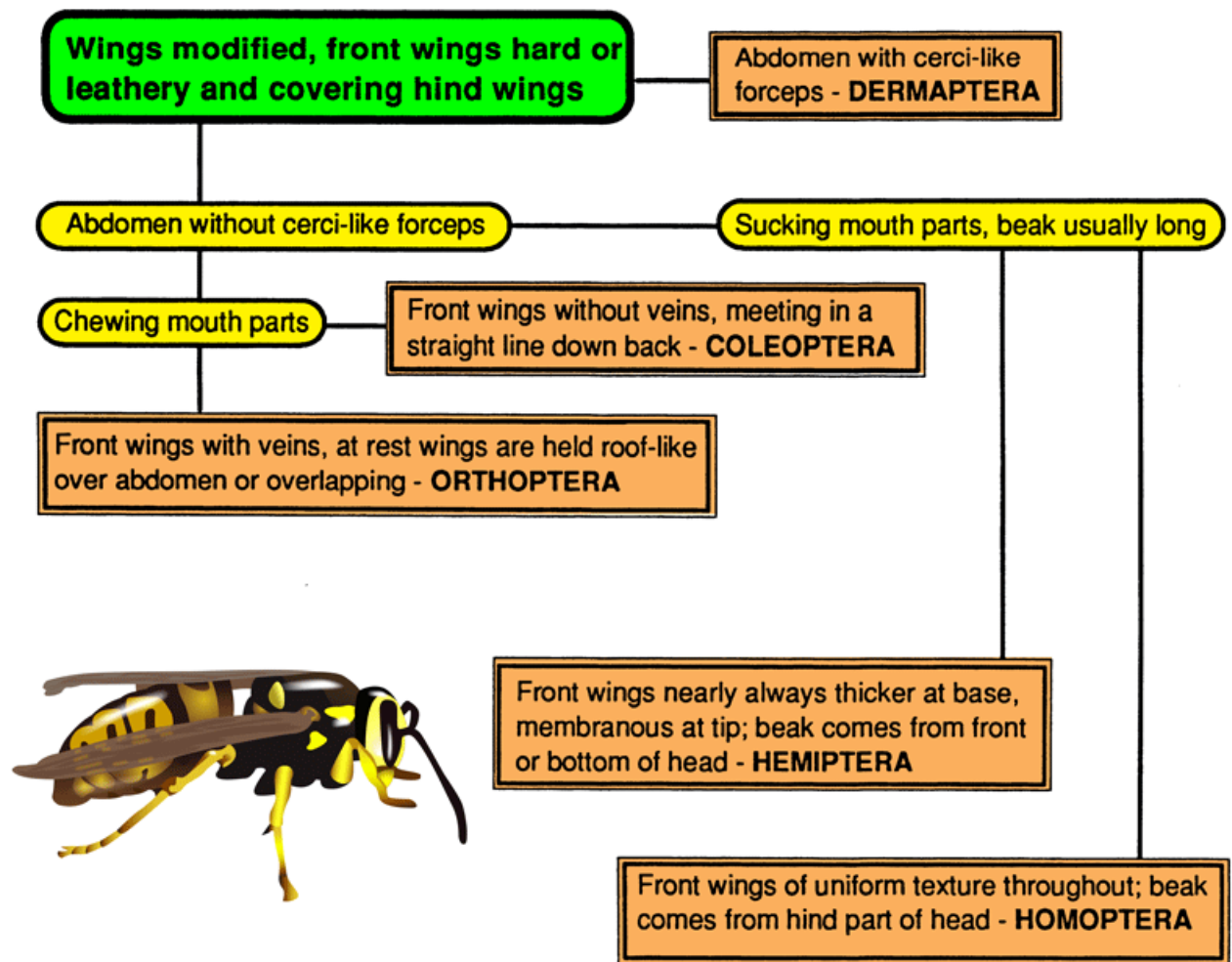
Insect Order	Meaning of Name	Common Name	Type of Metamorphosis	Type of Mouth Part
Phasmida	phantom	walking stick or leaf	incomplete	chewing
Isoptera	equal wings	termites	incomplete	chewing
Embioptera	lively wings	web spinners	incomplete	chewing
Thysanura	tassel tail	bristletails, silverfish	none	chewing
Collembola	glue peg	springtails	none	chewing
Coleoptera	sheath wings	beetles	complete	chewing or chewing-lapping
Zoraptera	pure, wingless	Zorapterans	incomplete	chewing
Orthoptera	straight wings	grasshoppers, crickets, locusts	incomplete	chewing
Lepidoptera	scale wings	butterflies, moths	complete	piercing-sucking
Mecoptera	long wings	scorpion flies	complete	chewing
Neuroptera	nerve wings	lacewings, dobson flies, ant lions, alderflies	complete	piercing-sucking
Diplura	double tail	campodeids, japygids	none	chewing
Hymenoptera	membrane wings	ants, bees, wasps	complete	chewing or chewing-sucking
Anoplura	unarmed tail	sucking lice	incomplete	piercing-sucking
Siphonaptera	tube, wingless	fleas	complete	reduced chewing
Dermaptera	skin wings	earwigs	incomplete	chewing
Odonata	toothed	dragonflies, damselflies	incomplete	chewing
Protura	first tail	Proturans	none	piercing-sucking or chewing
Grylloblattodea	cricket cockroach	rock crawlers, icebugs	incomplete	chewing

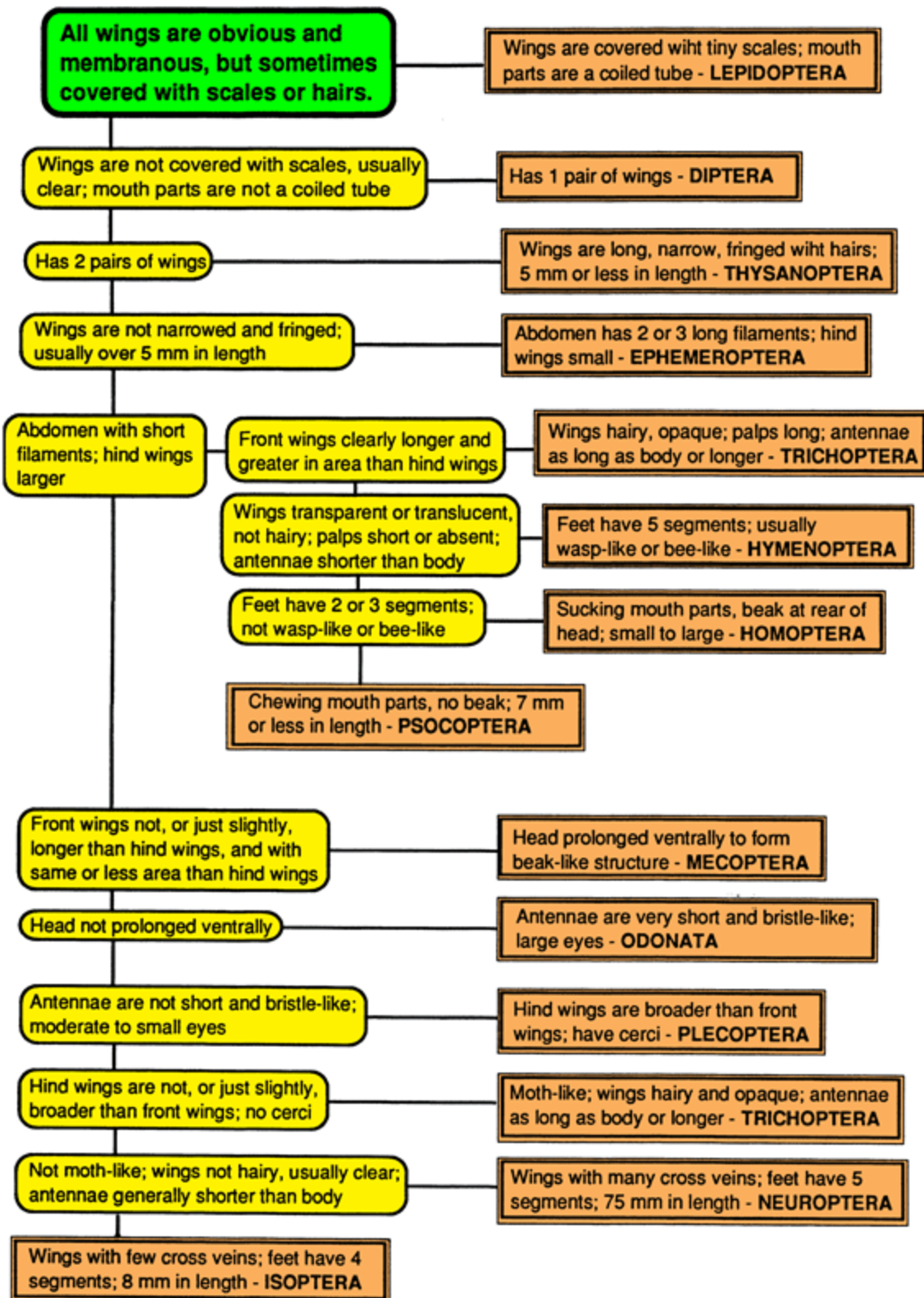
Systematic Method to Identify Insect Orders

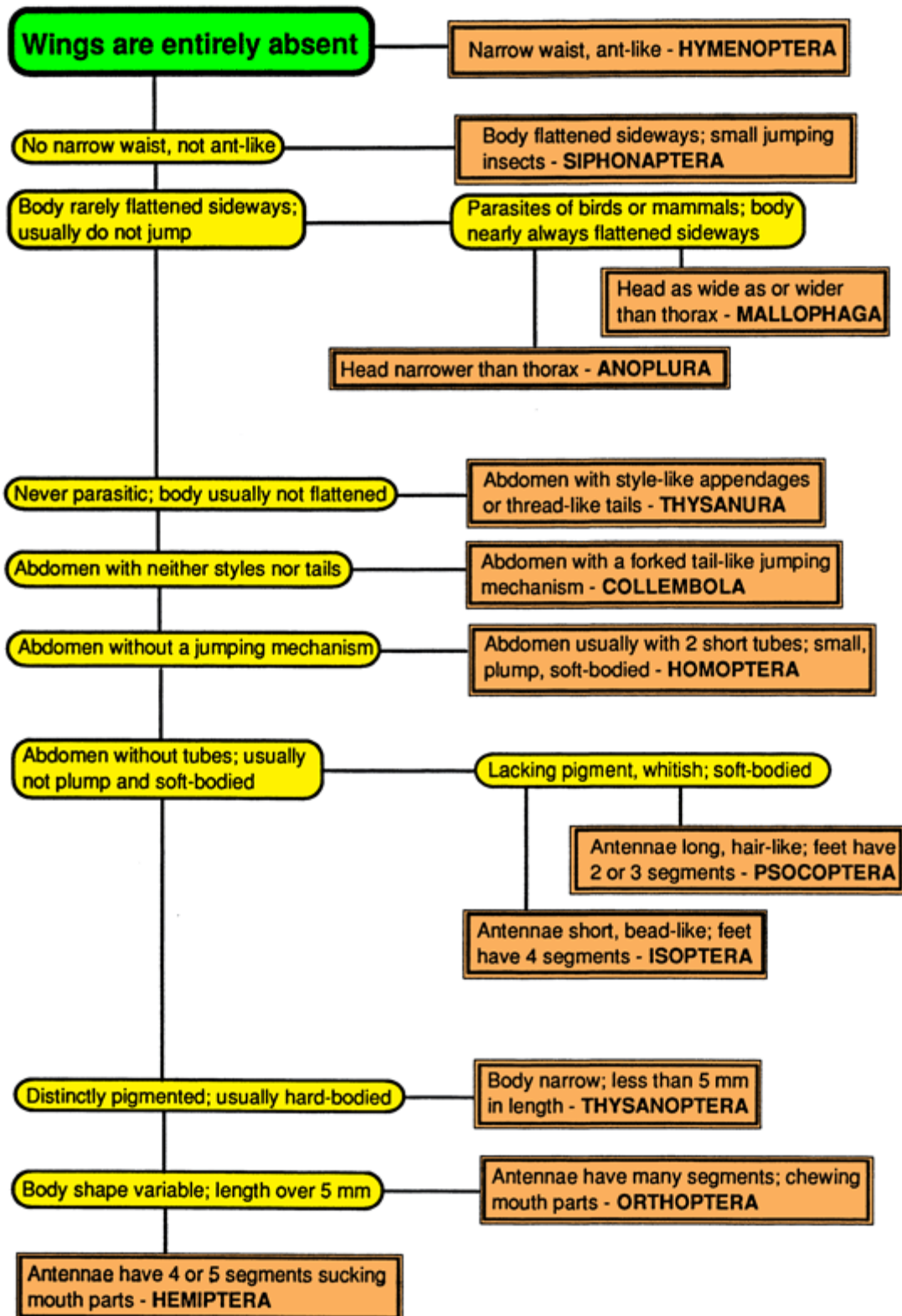
Keys are often used in identifying insects. Using a flow chart system helps to quickly identify insects and place them in the correct orders. To begin, first identify what type of wings the insect has. There are three main classes:

1. Wings are modified, front wings are hard and leathery and cover hind wings.
2. All wings are obvious and membranous, but sometimes they are covered with scales or hairs.
3. Wings are entirely absent.

Then, proceed through the flow chart identifying characteristics until the correct order is found. A rectangular box indicates an order and a rounded box indicates that further identification is needed.







Insect Fact Sheet

Directions: Fill in the information for the insect selected.

1. Scientific name: _____

2. Common name: _____

3. Order: _____

4. Type of mouth parts: _____

5. Write a brief description of the insect. Identify the features:

wings: _____

color: _____

antennae: _____

legs: _____

6. Describe the environment of the insect.

7. What is the insect's natural role in the environment?

8. What type of metamorphosis does the insect have?

9. Describe the life cycle of the insect.

10. How does this insect affect humans and society?

11. Methods of control:

How is this insect controlled by biological methods?

How is this insect controlled by mechanical methods?

How is this insect controlled by cultural methods?

How is this insect controlled by chemical methods?

12. On what crop would this insect most likely be found?

13. At what time during the growing season does this insect have the greatest effect on the crop?

14. Outline an IPM plan for this insect. Use the information you have found on the life cycle of the insect and the different control methods.

Insect Orders

Insect Order	Meaning of Name	Common Name	Type of Metamorphosis	Type of Mouth Part
Phasmida		walking stick or leaf	incomplete	chewing
	equal wings	termites		chewing
	lively wings		incomplete	
Thysanura			none	
		springtails	none	
		beetles		chewing or chewing-lapping
Zoraptera		Zorapterans		
	straight wings		incomplete	
		butterflies, moths	complete	
	long wings			chewing
Neuroptera	nerve wings			
	double tail	campodeids, japygids		
		ants, bees, wasps	complete	chewing or chewing-sucking
Anoplura			incomplete	
Siphonaptera				reduced chewing
		earwigs	incomplete	
		dragonflies, damselflies	incomplete	
Protura		Proturans		
	cricket cockroach	rock crawlers, icebugs		chewing

Unit: Entomology

Name _____

Lesson 3: Insect Identification

Date _____

Evaluation

Directions: Circle the letter that corresponds to the best answer.

1. What body features do all insects have in common?
 - a. Three body regions, six legs, wings
 - b. Hardened body regions, antennae, compound eyes
 - c. Three body regions, antennae, six legs
 - d. Hardened skeleton, antennae, wings

2. What are the three main parts of an insect?
 - a. Head, thorax, six legs
 - b. Head, antennae, and abdomen
 - c. Head, six legs, abdomen
 - d. Head, thorax, abdomen

3. Where are the legs of an insect attached?
 - a. The head and thorax
 - b. The thorax and abdomen
 - c. The abdomen
 - d. The thorax

4. What are two types of insect mouth parts?
 - a. Chewing and sucking
 - b. Sucking and slurping
 - c. Grinding and tearing
 - d. Tearing and siphon

5. Which two phases is an insect between when it makes a cocoon?
 - a. Nymph and adult
 - b. Pupa and adult
 - c. Larva and pupa
 - d. Nymph and pupa

6. In which stage are insects identified by instars and molting?
 - a. Immatures
 - b. Embryos
 - c. Adults
 - d. Molters

7. What is molting?
 - a. The stage when an insect begins its life as an adult
 - b. The stage when an insect emerges from the egg to become an embryo
 - c. The shedding of the hard, outer layer of skin between instars
 - d. The shedding of the soft, inner layer of skin between instars

8. How many insect orders are presently identified?
 - a. 32
 - b. 29
 - c. 26
 - d. 24

9. What are the two parts of the scientific name of an insect?
 - a. Order and family name
 - b. Genus and species name
 - c. First and last name
 - d. Incomplete and complete name

10. Why is an insect field guide used for insect identification?
 - a. Nobody can memorize all the information on insect classification.
 - b. You may not have a good insect collection handy.
 - c. Insect classification varies among entomologists.
 - d. They usually have simple descriptions and no pictures of an insect.

Course	Agricultural Science II
Unit	Entomology
Lesson	Methods of Control
Estimated Time	50 minutes

Student Outcome

Describe methods of pest control.

Learning Objectives

1. Identify the different pest control methods.
2. Identify the advantages and limitations of biological control methods.
3. Identify the advantages and limitations of cultural control methods.
4. Identify the advantages and limitations of physical and mechanical control methods.
5. Identify the advantages and limitations of chemical control methods.

Grade Level Expectations

SC/LO/3/B/09-11/d	SC/LO/3/B/09-11/e	SC/LO/3/D/09-11/b
SC/EC/1/A/09-11/a	SC/EC/1/A/09-11/b	SC/EC/1/B/09-11/a
SC/EC/1/B/09-11/b	SC/EC/1/C/09-11/b	SC/EC/1/D/09-11/b
SC/EC/3/B/09-11/a	SC/EC/3/C/09-11/b	SC/ST/1/B/09-11/a
SC/ST/1/C/09-11/a	SC/ST/3/B/09-11/a	SC/ST/3/B/09-11/b
SC/ST/3/B/09-11/c	SC/ST/3/D/09-11/a	

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites
 - ❑ Natural Insect Control. Golden Harvest Organics, LLC. Accessed December 7, 2007, from <http://www.ghorganics.com/page9.html>.
 - ❑ Entomology Answers. University of Missouri Extension. Accessed December 7, 2007, from <http://extension.missouri.edu/explore/qa/entomology0006.htm>.

Interest Approach

Demonstrate the effect and efficiency of the different types of pest control. Show why insect control is necessary. Ask the class to identify various ways to control or kill the common housefly. List answers on the board. Possible answers may include: hitting with hand (cultural control), hitting with fly-swatter (mechanical control), hanging a no-pest strip (mechanical control), screen doors and windows (mechanical control, barrier), spiders as predators (biological control), household insecticide spray (chemical control), and outdoor light zappers (mechanical). Identify the form of pest control demonstrated by each answer. Discuss the risks and benefits of each method. Discuss how the various methods can be combined and when one might consider each type of method.

This lesson will enable students to complete question 11, Methods of Control, on their Insect Fact Sheet (AS 1, Lesson 3).

Communicate the Learning Objectives

1. Identify the different pest control methods.
2. Identify the advantages and limitations of biological control methods.
3. Identify the advantages and limitations of cultural control methods.
4. Identify the advantages and limitations of physical and mechanical control methods.
5. Identify the advantages and limitations of chemical control methods.

Instructor Directions	Content Outline
Objective 1 <i>Insects have a great influence on many aspects of our lives. People compete with insects for food, fiber, and health in many areas. The control and management of insects is an important part of one's life as well.</i>	Identify the different pest control methods. <ol style="list-style-type: none">1. There are different ways to control insects.<ol style="list-style-type: none">a. Biological control methodsb. Cultural control methodsc. Physical and mechanical control methodsd. Chemical control methods2. The particular method or methods selected depend on the needs of the individual.
Objective 2 <i>Biological control is the use of naturally occurring organisms to control insects. These include: bacteria, diseases, fungi, viruses, insects, nematodes, birds, fish, toads and frogs, lizards, snakes, rodents, and weeds.</i>	Identify the advantages and limitations of biological control methods. <ol style="list-style-type: none">1. Four general areas of biological control<ol style="list-style-type: none">a. Using the insect's natural enemies – selectivity increasing the population of the insect's natural enemiesb. Resistant plant varieties – using plant varieties, occurring naturally and by genetic research, that are resistant to the insectc. Crop rotations – rotating the type of crop grown in a particular spot so that the same crop is not grown continuously

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> d. Sterilization – using chemicals or radiation to sterilize or to genetically alter insects so they cannot reproduce 2. Advantages <ul style="list-style-type: none"> a. Works with the insect’s natural enemies and environment b. Not necessarily expensive 3. Limitations <ul style="list-style-type: none"> a. Only partially effective b. Requires a lot of time to become effective c. Results are not guaranteed d. Not easy to control insects selectively e. An extensive knowledge of the insect’s life cycle and response to the environment is necessary f. Can be labor intensive g. Can be very expensive h. Not practical for commercial agriculture i. Cannot predict effect on the environment
<p>Objective 3</p> <p><i>Cultural control is the management of insect populations by modifying the environment. Standard production practices are used to make the environment less attractive or agreeable for insects.</i></p>	<p>Identify the advantages and limitations of cultural control methods.</p> <ul style="list-style-type: none"> 1. Five methods in cultural control <ul style="list-style-type: none"> a. Tillage systems b. Crop rotation c. Sanitation d. Timing of harvest and planting e. Water management 2. Advantages <ul style="list-style-type: none"> a. Does not require special machinery or equipment b. Uses standard agricultural or management practices c. Is not expensive d. Most practices do not require intensive labor 3. Limitations <ul style="list-style-type: none"> a. Only partially effective b. Not easy to control insects selectively c. An extensive knowledge of the insect’s life cycle and responses to the environment is necessary d. Can be labor intensive

Instructor Directions	Content Outline
<p>Objective 4</p> <p><i>Ask students how they physically or mechanically destroy insects.</i></p>	<p>Identify the advantages and limitations of physical and mechanical control methods.</p> <ol style="list-style-type: none"> 1. Physical and mechanical control methods <ol style="list-style-type: none"> a. Directly destroying insects b. Modifying the environment to make it unsuitable for insect pests c. Differ from cultural methods because, in addition to normal production practices, special machinery and equipment are used 2. Advantages <ol style="list-style-type: none"> a. Results are immediate and noticeable b. Based on standard agricultural or management practices 3. Limitations <ol style="list-style-type: none"> a. Only partially effective b. Not easy to control insects selectively c. An extensive knowledge of insect's life cycle and responses to the environment is necessary d. Can be labor intensive e. Can be expensive f. Limited application in commercial agriculture
<p>Objective 5</p> <p><i>Ask students about the kinds of insecticides with which they are familiar.</i></p> <p><i>Also discuss how the different methods of insect control may be used together for different situations. Encourage students to think about what is involved with each method and to compare the strengths and weaknesses of each. There are no real "right" or "wrong" answers. A person skilled in insect control needs to be able to use a variety of control methods.</i></p>	<p>Identify the advantages and limitations of chemical control methods.</p> <ol style="list-style-type: none"> 1. Classification of insecticides <ol style="list-style-type: none"> a. Organic insecticides – manufactured materials consisting mainly of carbon, hydrogen, and oxygen <ul style="list-style-type: none"> - Chlorinated Hydrocarbon: also called organic chlorines - Organic Phosphate: contains phosphorus - Carbamate: contains groups of nitrogen and hydrogen b. Inorganic insecticides – are made from minerals, are persistent, and do not break down easily in the environment c. Botanical insecticides – made from plants <ul style="list-style-type: none"> - Nicotine - Potenome - Dried pyrethrum flowers

Instructor Directions	Content Outline
	<p>d. Bacterial insecticides – infect insects with diseases, specifically kills one kind of insect, used on Japanese beetles and caterpillars</p> <p>2. Advantages</p> <ol style="list-style-type: none"> Works quickly and effectively Possible to control a particular insect selectively Only a general knowledge of the insect’s life cycle and responses to environment is needed Not labor intensive <p>3. Limitations</p> <ol style="list-style-type: none"> Buildup of insecticide-resistant insects Outbreaks of other harmful insects May have negative effects on the environment if not used properly Extremely dangerous to people <p>From the following questions, provide advantages and limitations of using different control methods together.</p> <ol style="list-style-type: none"> Which methods are most appropriate for commercial agriculture? Which methods are best suited for home and garden care? Which methods should be selected if insect control is needed immediately? Why? Why is the timing of insect control important? Why are labor intensive methods considered a limitation? Why is it necessary to consider the level of knowledge needed for activating a particular control method? How can the different methods be used together? Which methods would not work well together?
Application	<p>Other activities:</p> <p>Bring in different types of common household or garden insecticides. Have the students compare the labels for the amount of time necessary for effective use, types of insects killed, restrictions for use, and any harmful side effects to the environment.</p>
Closure/Summary	<p>There are several different methods for controlling insects. Each has its own advantages and limitations. The particular method or methods chosen depend on the</p>

Instructor Directions	Content Outline
	needs of the individual. Frequently, more than one method is used for the best control of insects.
Evaluation: Quiz	Answers: 1. c 2. b 3. a 4. a 5. d 6. d 7. d 8. c 9. b 10. Evaluate the responses based on what was discussed in class.

Unit: Entomology

Name _____

Lesson 4: Methods of Control

Date _____

Evaluation

Directions: Circle the letter that corresponds to the best answer.

1. What are the four groups of insect control methods?
 - a. Cultural, environmental, physical, and chemical
 - b. Biological, cultural, environmental, and genetic
 - c. Biological, cultural, physical and mechanical, and chemical
 - d. Physical and mechanical, chemical, insecticides, and biological

Correct answer is c.

2. What are the four areas of biological control?
 - a. Natural enemies, resistant varieties, tillage systems, sterilization
 - b. Natural enemies, resistant varieties, crop rotations, sterilization
 - c. Resistant varieties, crop rotations, sanitation, tillage systems
 - d. Organic phosphates, crop rotations, tillage systems, sterilization

Correct answer is b.

3. How is physical and mechanical control different from cultural control?
 - a. Physical and mechanical control uses special machinery or equipment in addition to standard production practices.
 - b. Physical and mechanical control uses special machinery or equipment instead of standard production practices.
 - c. Physical and mechanical control uses special chemicals in addition to standard production practices.
 - d. Physical and mechanical control uses special machinery or equipment in addition to standard chemical control.

Correct answer is a.

4. How can removing weeds and crop residues help control insects?
 - a. Removes a favorable living environment for insects
 - b. Attracts insects that spread to crop plants
 - c. Keeps insects alive between crop plantings
 - d. Provides an underground haven for insects

Correct answer is a.

5. Which of the following does not involve the timing of insect control to reduce insect populations?

- a. Insects can be destroyed before they complete their life cycle.
- b. Insect reproduction can be inhibited or prevented.
- c. Insect food sources can be limited and their numbers reduced.
- d. Insects can be sprayed with insecticides.

Correct answer is d.

6. Which of the following is an advantage of crop rotation?

- a. Changing the host species and environment increases insect population build up.
- b. Involves a higher level of management skills.
- c. Especially effective with insects that are very mobile.
- d. Disrupts the life cycle of the insect.

Correct answer is d.

7. Why is the amount of labor necessary for a particular control method important?

- a. An individual must consider the cost of additional labor.
- b. Control measures may need to be done within a certain amount of time.
- c. Seasonal labor may not be available at the needed time.
- d. All of the above

Correct answer is d.

8. What are the three groups of organic insecticides?

- a. Inorganics, botanicals, and bacterials
- b. Bacterials, organic phosphates, and carbamates
- c. Chlorinated hydrocarbons, organic phosphates, and carbamates
- d. Nicotines, chlordanes, and malathions

Correct answer is c.

9. When are chemical insecticides most likely to be harmful to the environment?

- a. When they are extremely dangerous
- b. When they are not applied properly
- c. When they enter the environment very quickly
- d. When they are persistent and are not very easily broken down in the environment

Correct answer is b.

The rest are essay questions.

Directions: Complete the following short answer question.

10. What are the advantages and limitations of using different control methods together?

Course	Agricultural Science II
Unit	Entomology
Lesson	Chemical Control Methods
Estimated Time	50 minutes

Student Outcome

Describe the factors in the selection and application of insecticides.

Learning Objectives

1. Define pesticides.
2. Distinguish when an insect is considered a pest.
3. Identify the different types of pesticides.
4. Describe the mode of action for different types of insecticides.
5. Identify the methods of insecticide application.
6. Identify the different formulations of insecticides.
7. Describe how insecticides are applied.
8. Distinguish why it is important to calibrate a sprayer accurately.

Grade Level Expectations

SC/EC/1/B/09-11/a	SC/EC/1/B/09-11/b	SC/EC/1/C/09-11/b
SC/EC/1/D/09-11/b	SC/EC/3/C/09-11/b	SC/ST/1/B/09-11/a
SC/ST/1/C/09-11/a	SC/ST/3/B/09-11/a	SC/ST/3/B/09-11/b
SC/ST/3/B/09-11/c	SC/ST/3/D/09-11/a	

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. PowerPoint Slide
 - PPt 1 - Nozzle Types
2. Handout
 - HO 1 - Calibrating Sprayers
3. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
4. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- Several containers of common household chemicals
- Different types of sprayers, if possible

Supplemental Information

1. Internet Sites

- ❑ Calibrating Field Sprayers. University of Missouri Extension. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/agguides/agengin/g01270.htm>.
 - ❑ National Pesticide Information Center. Accessed January 24, 2008, from <http://npic.orst.edu/>.
 - ❑ Pesticide Education Center. Accessed January 24, 2008, from <http://www.pesticides.org/>.
 - ❑ Types of Pesticides. U.S. Environmental Protection Agency. Accessed January 24, 2008, from <http://www.epa.gov/pesticides/about/types.htm>.
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Interest Approach

Have several containers of common household chemicals on display. The containers could be from home, a drugstore, a grocery, or a gardening supply store. Compare the information (e.g., ingredients, mode of action, safety precautions) on the labels.

Communicate the Learning Objectives

1. Define pesticides.
2. Distinguish when an insect is considered a pest.
3. Identify the different types of pesticides.
4. Describe the mode of action for different types of insecticides.
5. Identify the methods of insecticide application.
6. Identify the different formulations of insecticides.
7. Describe how insecticides are applied.
8. Distinguish why it is important to calibrate a sprayer accurately.

Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Pesticides are an important part of any insect control plan. Point out that insecticides are pesticides that are specifically made for controlling insects.</i></p>	<p>Define pesticides.</p> <p>The term pesticide is a general term used for any chemical used to kill any pest.</p>
<p>Objective 2</p> <p><i>Discuss with students when an insect is considered a pest and when it is considered a beneficial insect.</i></p>	<p>Distinguish when an insect is considered a pest.</p> <p>Insects are considered pests when they compete with humans for food and fiber or attack people directly.</p>
<p>Objective 3</p> <p><i>Pesticides are classified by the types of pests they are designed to control. The pest for which a pesticide is intended is called the target pest. The target pests are listed after the type of pesticide. Chemical control methods are often used to control harmful insects because they are very effective, easy to apply, quick acting, usually economical, target specific, and practical for commercial use.</i></p>	<p>Identify the different types of pesticides.</p> <ol style="list-style-type: none">1. Acaricide – mites and ticks2. Avicide – birds3. Bactericide – bacteria4. Fungicide – fungi5. Herbicide – weeds6. Insecticide – insects7. Miticide – mites8. Molluscicide – snails and slugs9. Nematicide – nematodes10. Piscicide – fish11. Rodenticide – rodents (rats and mice)

Instructor Directions	Content Outline
<p>Objective 4</p> <p><i>How an insecticide works is called the mode of action. Encourage students to discuss in what insect control situations would the different modes of action be the most effective.</i></p>	<p>Describe the mode of action for different types of insecticides.</p> <ol style="list-style-type: none"> 1. Contacts 2. Systemics 3. Fumigants 4. Protectants 5. Sterilants 6. Selective insecticides 7. Nonselective insecticides 8. Growth regulators 9. Biologicals
<p>Objective 5</p> <p><i>Discuss the importance of applying an insecticide using the proper method. Point out that some insecticides may not work if applied by the wrong method.</i></p>	<p>Identify the methods of insecticide application.</p> <ol style="list-style-type: none"> 1. Pre-emergence 2. Preplant 3. Band 4. Broadcast 5. Dip 6. Directed 7. Drench 8. Foliar 9. In-furrow 10. Over-the-top 11. Pour-on 12. Sidedress 13. Soil incorporation 14. Spot treatment
<p>Objective 6</p> <p><i>An insecticide formulation refers to the specific way the product is made. Students can be asked for examples of each of these formulations. Insecticides are made and applied as a liquid, gas, or solid. Most formulations have a letter abbreviation.</i></p>	<p>Identify the different formulations of insecticides.</p> <ol style="list-style-type: none"> 1. Liquid formulations <ol style="list-style-type: none"> a. Emulsifiable concentrate (EC or E) b. Flowables (F or L) c. Solutions (S) d. Ultra-low-volume solutions (ULV) e. Aerosols (A) f. Liquified gases 2. Dry formulations <ol style="list-style-type: none"> a. Dusts (D) b. Granules (G) c. Soluble powders (SP) d. Wettable powders (WP or W) e. Baits (B)

Instructor Directions	Content Outline
<p>Objective 7</p> <p><i>The application equipment, which depends on the insecticide formulation, is very important for proper application of insecticides. Insecticides may be sprayed, dusted, used in a dipping tank, injected, or mixed with insect food. If possible, different types of sprayers can be shown as visual aids. Refer to PPt 1 when discussing nozzle types.</i></p> <p>☐ PPt 1 - Nozzle Types</p>	<p>Describe how insecticides are applied.</p> <ol style="list-style-type: none"> 1. Sprayers <ol style="list-style-type: none"> a. Hand sprayers b. Low-pressure field sprayers c. High-pressure sprayers d. Air-blast sprayers e. Ultra-low-volume (ULV) sprayers 2. Nozzle types <ol style="list-style-type: none"> a. Solid stream b. Flat fan c. Hollow cone d. Solid cone e. Broadcast
<p>Objective 8</p> <p><i>Calibrating a sprayer means adjusting the equipment so that the insecticide is applied at the desired rate. There are several ways to calibrate sprayers, depending on the equipment used and personal preference. Several ways are presented in HO 1. Stress the importance of always taking the time to calibrate and check equipment.</i></p> <p>☰ HO 1 - Calibrating Sprayers</p>	<p>Distinguish why it is important to calibrate a sprayer accurately.</p> <ol style="list-style-type: none"> 1. It is important to accurately calibrate a sprayer so that each insecticide is used as directed on the label. 2. The best results are obtained by correct calibration. Too much insecticide is dangerous, costly, and wasteful. Too little insecticide will not do an effective job.
<p>Application</p>	<p>Other activities:</p> <ol style="list-style-type: none"> 1. Have students visit an equipment shop or supply store to see the different kinds of insecticides, application equipment (e.g., sprayers, nozzles), and calibration charts. 2. Have students take home problems on calibrating sprayers. 3. Invite a custom insecticide applicator or insecticide dealer to demonstrate how to calibrate a sprayer. If the shop doesn't have the appropriate equipment, ask the individual to bring it for the demonstration.

Instructor Directions	Content Outline
Closure/Summary	<p>Chemical insecticides are commonly used as part of an effective insect control plan. There are many kinds of chemicals from which to choose. Each works in its own particular way. It is very important to select the insecticide formulation and equipment that are most appropriate for the job. Insecticides must be properly applied and the equipment accurately calibrated for effective and safe insect control.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. A pesticide is a general term for any chemical used to kill any pest, whereas an insecticide refers to chemicals that specifically kill insects. 2. Any 6 of the following: contacts, systemics, fumigants, protectants, sterilants, selective insecticides, non-selective insecticides, growth regulators, biologicals 3. Any 6 of the following: pre-emergence, preplant, band, broadcast, dip, directed, drench, foliar, in-furrow, over-the-top, pour-on, sidedress, soil incorporation, spot treatment 4. b 5. c 6. c 7. d 8. a 9. b 10. b

Calibrating Sprayers

Single Nozzle Hand or Small Sprayers

Method 1:

1. Mark off an area 10 feet by 10 feet.
2. Fill sprayer to a known mark and spray the area.
3. Refill the sprayer, measuring the amount of water required to refill to original level.
4. Determine the rate of spray delivery per acre for one nozzle:

<u>Nozzle discharge per 100 square feet</u>	<u>Amount of spray delivered per acre</u>
1/2 pint (1 cup)	27 gallons
1 pint	55 gallons
1-1/2 pints	82 gallons
1 quart	110 gallons

Applying 1 pint/100 square feet is equal to 1 gallon/800 square feet or 3 gallons/2,400 square feet (24 feet x 100 feet).

Method 2:

1. Record the time while spraying 1 square rod (16-1/2 feet x 16-1/2 feet).
2. Catch the discharge from the nozzle in a bucket or other container for same period of time.
3. Measure the spray caught in pints.
4. Multiply the number of pints by 20. This equals the gallons per acre.

Field or Large Sprayer

Method 1:

1. Hang a container under each nozzle.
2. Operate the sprayer at the usual application pressure until about 1 pint of water has been collected in each of the containers.

3. Measure and record the output of each nozzle. Measurements can be made by the dip stick method, in ounces, cubic centimeters, etc.
4. Determine the total output collected from all the nozzles.
5. Determine the average by dividing the total output by the number of nozzles on the boom.
6. Multiply the average by 5 percent.
7. Subtract this figure from the average. This will be the low side of the 10 percent allowed.
8. Add this 5 percent figure to the average. This will be the high side of the 10 percent allowed.
9. The allowed 10 percent spread is between the low figure and the high figure.
10. Compare the output of each nozzle to these low and high figures.
 - a. Take apart and clean all nozzles with an output below the low figure.
 - b. Replace the nozzle with an output greater than the high figure with a new one.
11. After cleaning and replacing the nozzles, repeat steps 1 through 10. Frequently, the output of new nozzles varies greater than the allowed 10 percent.

The sprayer should be rechecked often, even after the original calibration. Be sure the same area is sprayed for each tankful as was planned in the calculation. If more or less area is sprayed than planned, stop spraying and recalibrate. This allows you to catch a small error in calculation or sprayer delivery rate before a major mistake is made. Equipment needs to be recalibrated whenever a different rate of application is used.

Method 2: Sprayer Calibration by the Ounce Method

Equipment needed:

- 100-foot tape
- watch with a second hand
- container graduated in **ounces** (liquid)

1. Select from the table below the appropriate distance based on:
 - a. **Row spacing** is for a single nozzle or a group of nozzles directed at the row.
 - b. **Nozzle spacing** is broadcast spraying over a non-row crop.
 - c. **Band width** is band spraying. Measure off this distance in the field.

<u>Row spacing, nozzle spacing, or band width (inches)</u>	<u>Distance (feet)</u>
40	102
38	107
36	113
34	120
32	127
30	136
28	146
26	157
24	170
22	185
20	204
18	227
16	255
14	291
12	340
10	410
8	508

2. Drive the measured distance at the speed setting you desire to operate the sprayer. Accurately record the time in seconds.
3. Place the container graduated in ounces underneath one nozzle or nozzle group. Operate the spray in place at the selected pressure. Catch the discharge for the same amount of time, in seconds, as was recorded in Step 2.
4. The total discharge from the nozzle or nozzle groups, in ounces, has the same numerical value as the total gallons/acre (broadcast) applied by the sprayer.
5. To determine the number of acres that can be treated with a full sprayer tank, divide the total capacity of the sprayer tank by the gallons/acre value from Step 4.
6. If **band spraying**, modify the gallons/acre (broadcast) from Step 4 and the insecticide rate (broadcast) with the following formulas.

$$\text{Gallons/acre} = \frac{\text{broadcast rate} \times \text{band width}}{\text{row spacing}}$$

$$\text{Amount of insecticide needed per acre} = \frac{\text{broadcast rate} \times \text{band width}}{\text{row spacing}}$$

7. Always recalibrate when the pressure, speed, and/or nozzles are changed.

Applying Dusts and Granular Formulations

Before starting a dusting operation, the application equipment must be checked and calibrated. Even if the regulator on the equipment is at a given setting, the rate of application can change because different dust mixtures have different densities.

1. Read the operator's manual supplied by the manufacturer. Follow the instructions for adjusting equipment to the proper settings for the product and application rate being used.
2. Fill each hopper to an easily determined level or mark.
3. Measure off an area at least $1/4$ acre or 1,000 feet of row. *Example:* Eight 40-inch rows $1/4$ mile long equals 0.808 acres.
4. Dust the measured area. Drive at a constant speed and use a speedometer if possible. The speed affects the application rate. A constant speed is necessary to apply the insecticide evenly and accurately.
5. Refill the hopper to the same level. Carefully weigh the amount of insecticide needed to refill the hopper. Another way to do this is to weigh accurately a given amount of the dust product. Refill the hopper with this dust. Weigh the amount of dust leftover. Subtracting the second weight from the first weight will give the amount of dust needed to refill the hopper.
6. The amount of insecticide dust it takes to refill the hopper is the amount applied to the measured area or distance.
7. Determine the application rate by dividing the amount applied by the area.

Example: Suppose a bag contains 50 pounds of dust product. This was used to refill the hopper. After refilling the hopper, the bag weighed 34 pounds. Sixteen pounds were applied (50 pounds - 34 pounds = 16 pounds). Dividing 16 pounds by 0.808 acres gives 19.8 pounds per acre.

8. If the amount applied does not fall within 5 percent of the recommended dosage, reset the gate openings and repeat the previous three steps.
9. Keep a record of the acreage treated with each filling of the hopper. This will let you see any slight change in rate of application and make the necessary adjustments.

Unit: Entomology

Name _____

Lesson 5: Chemical Control Methods

Date _____

Evaluation

These are essay - skip to question 4.

Directions: Complete the following short answer questions.

1. What is the difference between a pesticide and an insecticide?

2. Name six ways insecticides work (mode of action).

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

3. Name six terms used to describe the methods of insecticide application.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

Directions: Circle the letter that corresponds to the best answer.

4. When are insects not considered pests?

- a. When they compete with humans for food, fiber, or health
- b. When they destroy other insects that eat crop plants
- c. When they tunnel or bore into stems, stalks, roots, and branches
- d. When they suck the sap from leaves, stems, roots, fruits, and flowers

Correct answer is b.

5. Which of the following is not a consideration when selecting the insecticide formulation?
- a. The type of coverage needed
 - b. The type and condition of the target plant or animal
 - c. The calibration of the equipment
 - d. The formulation

Correct answer is c.

6. What is the key to using insecticides effectively?
- a. Selecting the right insecticide formulation
 - b. Calibrating the sprayer accurately
 - c. Following the directions on the label
 - d. Selecting the best nozzle type

Correct answer is c.

7. What is the purpose of the inactive, or inert, ingredient in an insecticide formulation?
- a. These materials activate the active ingredient.
 - b. These materials are the chemicals that kill the insects.
 - c. These materials bring the mass of the bag to the proper weight.
 - d. These materials make the active ingredient easier to apply.

Correct answer is d.

8. Why are weather conditions important when applying insecticides?
- a. Weather conditions can change the effectiveness of insecticides.
 - b. Rain can help spread the insecticide around for greater coverage.
 - c. Winds help spread the insecticide for greater coverage.
 - d. Rain can help insecticides soak into the ground.

Correct answer is a.

9. Which of the following would not change the rate of insecticide delivered to an area?
- a. Change in the pressure
 - b. Change in the tank volume
 - c. Change in speed
 - d. Change in the nozzle tips

Correct answer is b.

10. Why is it important to calibrate a sprayer properly?
- a. Sprayers do not need to be properly calibrated.
 - b. Each insecticide must be applied as directed on the label.
 - c. Applying too much insecticide can increase insect resistance.
 - d. Applying too little insecticide can pollute the soil.

Correct answer is b.

Course	Agricultural Science II
Unit	Entomology
Lesson	Safe Use of Insecticides
Estimated Time	Two 50-minute blocks

Student Outcome

Identify safety guidelines for insecticide use.

Learning Objectives


1. Describe what information is located on an insecticide label.
2. Distinguish how insecticide toxicity is measured.
3. Describe what certifications are required for pesticide applicators.
4. Identify what the safety guidelines are for using insecticides.
5. Identify the safe ways to dispose of insecticides and insecticide containers.
6. Describe symptoms of insecticide poisoning.
7. Identify the correct first aid procedures for insecticide poisoning.
8. Identify what supplies should be included in a first aid kit.
9. Identify where the nearest Poison Control Center is.

Grade Level Expectations

SC/EC/1/B/09-11/a	SC/EC/1/B/09-11/b	SC/EC/1/C/09-11/b
SC/EC/1/D/09-11/b	SC/EC/3/C/09-11/b	SC/ST/1/B/09-11/a
SC/ST/1/C/09-11/a	SC/ST/3/B/09-11/a	SC/ST/3/B/09-11/b
SC/ST/3/B/09-11/c	SC/ST/3/D/09-11/a	

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. Activity Sheet
 -  AS 1 – Reading an Insecticide Label
2. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
3. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplies & Equipment

- Labels from several different types of insecticides
- Various types of protective clothing and equipment

Supplemental Information

1. Internet Sites
 - Poison Center. SSM Cardinal Glennon Children’s Medical Center. Accessed January 28, 2008, from <http://www.cardinalglennon.com/internet/home/glennon30.nsf/documents/Poison+Center?OpenDocument>.

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- ❑ Using Insecticides. Michigan State University Extension. Accessed January 28, 2008, from <http://web1.msue.msu.edu/imp/mod02/01500536.html>.

2. Print


- ❑ *Applying Pesticides Correctly: A Guide for Commercial Applicators* (Guide MX328). Columbia: University of Missouri Extension in cooperation with the Environmental Protection Agency, reviewed 2007. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/miscpubs/mx0328.htm>.
 - ❑ Baker, D.E. *Pesticide Application Safety* (Guide G1916). Columbia: University of Missouri Extension, revised 1997. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/agguides/agengin/g01916.htm>.
 - ❑ Fishel, F. *Personal Protective Equipment for Working With Pesticides* (Guide G1917). Columbia: University of Missouri Extension, reviewed 2001. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/agguides/agengin/g01917.htm>.
 - ❑ Fishel, F., and Paul A. *Pesticide Poisoning Symptoms and First Aid* (Guide G1915). Columbia: University of Missouri Extension, reviewed 2002. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/agguides/agengin/g01915.htm>.
 - ❑ Kroening, M. *Using Pesticides Safely Around the Home* (Guide G1918). Columbia: University of Missouri Extension, revised 2007. Accessed June 10, 2008, from <http://extension.missouri.edu/xplor/agguides/agengin/g01918.htm>.
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Interest Approach

1. Have students compare the labels of several different types of insecticides. AS 1 can be used to help stimulate questions.
2. Demonstrate the various types of protective clothing and equipment.
3. Ask the class to identify how insecticides affect our everyday lives, both positively and negatively. Topics could include environmental activities, safety precautions for insecticide use, and insecticides required to produce and preserve food and fiber for society.

Communicate the Learning Objectives

1. Describe what information is located on an insecticide label.
2. Distinguish how insecticide toxicity is measured.
3. Describe what certifications are required for pesticide applicators.
4. Identify what the safety guidelines are for using insecticides.
5. Identify the safe ways to dispose of insecticides and insecticide containers.
6. Describe symptoms of insecticide poisoning.
7. Identify the correct first aid procedures for insecticide poisoning.
8. Identify what supplies should be included in a first aid kit.
9. Identify where the nearest Poison Control Center is.


Instructor Directions	Content Outline
<p>Objective 1</p> <p><i>Discuss with students the information found on an insecticide label. The instructor may want to point out the information on several different insecticide labels. Have students complete AS 1.</i></p> <p> AS 1 – Reading an Insecticide Label</p>	<p>Describe what information is located on an insecticide label.</p> <ol style="list-style-type: none">1. Type of insecticide2. Target insects3. Application techniques4. How the product affects different plants and animals5. Toxicity level6. Signal words7. Safety guidelines8. Disposal methods9. First aid procedures
<p>Objective 2</p> <p><i>Discuss with students how insecticide toxicity is measured. Also discuss why it is important to measure the toxicity level.</i></p>	<p>Distinguish how insecticide toxicity is measured.</p> <ol style="list-style-type: none">1. LD₅₀ is a standard measure of toxicity.<ol style="list-style-type: none">a. “LD” stands for the “lethal dose” of the insecticide. This is expressed in milligrams of insecticide per kilogram of body weight necessary to kill half of a test population (such as mice, guinea pigs, rabbits).b. The lower the LD number, the greater the insecticide toxicity and the less it takes to kill.

Instructor Directions	Content Outline
	<ol style="list-style-type: none"> 2. Signal words are used to indicate the level of toxicity and precautions for the product. They are located directly below the statement "Keep Out of Reach of Children." <ol style="list-style-type: none"> a. Class I: "Danger or Danger-Poison" with an accompanying drawing of a skull and crossbones <ul style="list-style-type: none"> - Letters printed in red - Highly toxic category - Oral LD₅₀ rating of 0-50 b. Class II: "Warning" <ul style="list-style-type: none"> - Moderately toxic category - Oral LD₅₀ rating of 50-500 c. Class III: "Caution" <ul style="list-style-type: none"> - Slightly toxic category - Oral LD₅₀ rating of 500-5,000
<p>Objective 3</p> <p><i>Discuss with students what certifications are required for pesticide applicators. Give information about the place where students can obtain the certification.</i></p>	<p>Describe what certifications are required for pesticide applicators.</p> <ol style="list-style-type: none"> 1. There are two classifications of pesticides. Some pesticides may be a combination of the two. The classification is listed on the product label. <ol style="list-style-type: none"> a. "General use" pesticides are not likely to harm people, wildlife, and/or the environment when used according to label directions. <ul style="list-style-type: none"> - Examples are Malathion, Sevin, and Pyronone. - Certification is not required. b. "Restricted use" pesticides could cause serious injury to people, wildlife, or the environment unless applied by a well-trained and competent pesticide applicator, or under the direct supervision of such an applicator. <ul style="list-style-type: none"> - Examples are Lannate, Nicotine and Thiodan. - Certification is required. 2. There are two types of licenses for certified pesticide applicators. <ol style="list-style-type: none"> a. Private applicator <ul style="list-style-type: none"> - Administer restricted use pesticides onto their own land, onto land they rent, or onto property of a person with whom they trade services - Receive training in pesticide application - Common type of license for most producers

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> - License valid for 5 years and then must be renewed b. Commercial applicator <ul style="list-style-type: none"> - Apply restricted use pesticides on the property of others - Receive training in pesticide application as well as specialized training - License valid for 3 years and then must be renewed
<p>Objective 4</p> <p><i>Discuss with students safety guidelines for using insecticides. Emphasize how important it is to read and follow all insecticide label directions.</i></p>	<p>Identify what the safety guidelines are for using insecticides.</p> <ol style="list-style-type: none"> 1. Always read and follow label directions exactly. 2. Remove all people, pets, and foodstuffs prior to insecticide application. 3. When spraying in an enclosed environment, close all doors, vents, and openings before applying insecticides in order to avoid insecticide drift. 4. Never smoke, eat, or drink while applying insecticides. 5. Always wear protective clothing and use protective equipment to prevent exposure to external irritant insecticides. <ol style="list-style-type: none"> a. Wear clean long trousers and a long-sleeved shirt, or coveralls made of closely woven cloth. b. Wear unlined rubber gloves and rubber boots made of neoprene. c. Wear shirt sleeves outside of the gloves and wear pant legs outside of the boots to prevent pesticides from entering. d. Wear close-fitting eye goggles or a face shield. e. Wear a wide-brimmed waterproof hat, one that is easy to clean or is disposable. f. Wear a respiratory device that prevents internal poisoning whenever applying an insecticide. g. Clean clothing and equipment as directed by the insecticide label or by the Poison Control Center recommendations. 6. Always wear a respiratory device approved by an appropriate agency (NIOSH and MSHA) to prevent internal poisoning. <ol style="list-style-type: none"> a. Cartridge respirator - used for occasional exposure to most insecticides.

Instructor Directions	Content Outline
	<ul style="list-style-type: none"> b. Gas mask or canister respirator – used when the applicator is exposed to an insecticide for a relatively long period of time or is exposed to high concentrations of insecticides for a short period of time, and working in a confined or closed area. c. Self-contained breathing apparatus – used if the oxygen supply is low or the insecticide vapor concentration is high <ol style="list-style-type: none"> 7. Always take precautions to avoid insecticide drift. 8. Shower and shampoo after applying insecticides. 9. Wash clothing exposed to insecticide separately from other clothing or if disposable, dispose of properly. 10. Maintain a health watch program with a physician if applying insecticides on a regular basis. <ul style="list-style-type: none"> a. Inform the doctor of the exact insecticides used so he or she can review chemical formulations and stock a supply of antidotes. b. Follow special instructions for persons applying carbamate or organophosphate insecticides. <ul style="list-style-type: none"> - Establish a regular cholinesterase testing program with a doctor. - Have a “baseline” test taken in January. - Have periodic follow-up tests for cholinesterase level. If cholinesterase level falls too low, the doctor will limit or stop applicator’s contact with these two insecticides until level returns to normal range.
<p>Objective 5</p> <p><i>Discuss with students the safe ways to dispose of insecticides and insecticide containers. For help with safe disposal of insecticides and/or insecticide containers, contact the Missouri Department of Natural Resources.</i></p>	<p>Identify the safe ways to dispose of insecticides and insecticide containers.</p> <ol style="list-style-type: none"> 1. Read and follow insecticide container label instructions and/or precautions for disposal. 2. Apply any surplus insecticide to other areas with the same pest problem. 3. Never flush insecticides down the drain, into sewers, or into waterways. 4. Take unwanted insecticides and/or insecticide containers to a toxic waste disposal landfill.

Instructor Directions	Content Outline
<p>Objective 6</p> <p><i>Discuss with students the symptoms of insecticide poisoning. Point out that there are no standard symptoms.</i></p>	<p>Describe symptoms of insecticide poisoning.</p> <ol style="list-style-type: none"> 1. There are no standard symptoms of insecticide poisoning. Symptoms vary depending on several factors. <ol style="list-style-type: none"> a. Kind and amount of insecticide b. Length of exposure c. Time interval between exposures d. General health of the victim 2. There are two categories of insecticide poisoning. Many insecticides fit in both categories. <ol style="list-style-type: none"> a. External irritants – those which sting the nose, eyes, ears, throat, and mouth due to insecticide splashing on external tissues. b. Internal poisons – those which injure body organs due to insecticide being taken into the body through the mouth or skin.
<p>Objective 7</p> <p><i>Discuss with students the correct first aid procedures for insecticide poisoning.</i></p> <p><i>Note: If an insecticide accident occurs at school, the instructor should notify the school nurse as soon as possible.</i></p>	<p>Identify the correct first aid procedures for insecticide poisoning.</p> <ol style="list-style-type: none"> 1. Act as quickly as possible. 2. Without endangering yourself, remove the victim from the contaminated area. 3. Remove contaminated clothing from the victim. 4. Generously flood the affected skin area or eye with water. 5. Contact the Poison Control Center or a doctor. 6. Administer first aid as indicated by Poison Control Center personnel or a doctor.
<p>Objective 8</p> <p><i>Discuss with students the importance of having a first aid kit available.</i></p> <p><i>Note: It is crucial that the school shop have a complete first aid kit available. Poison Control Center personnel or a doctor will indicate first aid procedures that need to be followed.</i></p>	<p>Identify what supplies should be included in a first aid kit.</p> <ol style="list-style-type: none"> 1. Adhesive tape 2. Assorted bandages 3. Blanket 4. Merthiolate 5. Syrup of ipecac 6. Teaspoon 7. Two quarters (for phone calls)

Instructor Directions	Content Outline
<p>Objective 9</p> <p><i>Discuss with students information about the nearest Poison Control Center. The instructor should post the toll-free number by the telephone so it is handy in the event of insecticide poisoning.</i></p>	<p>Identify where the nearest Poison Control Center is.</p> <ol style="list-style-type: none"> Missouri's center is staffed 24 hours by medical professionals. Missouri Regional Poison Control Center Cardinal Glennon Memorial Hospital 1465 South Grand Avenue St. Louis, MO 63104 Phone: 1-800-222-1222 It is important to have the insecticide label with you when talking with the Poison Control Center.
<p>Application</p> <p> AS 1 – Reading an Insecticide Label</p>	<p>Answers to AS 1: The instructor will need to determine if answers are appropriate.</p> <p>Other activities:</p> <ol style="list-style-type: none"> Visit a local farm or garden supply store to see their insecticide application equipment, including respirators and protective clothing. Require students to take notes on their observations. Students may be asked to prepare a written report on the field trip. Invite an extension agent or other specialist to talk about insecticide safety.
<p>Closure/Summary</p>	<p>Insecticide applicators must know and practice the principles of safe insecticide use in order to protect themselves, animals, and/or the environment from the effects of toxic insecticides. Always read and follow all insecticide label directions.</p>
<p>Evaluation: Quiz</p>	<p>Answers</p> <ol style="list-style-type: none"> b a c d d b a b c

Instructor Directions	Content Outline
	<p>10. External irritants - such as stinging of nose, eyes, ears, throat, and mouth due to insecticide splashing on external tissues</p> <p>Internal poisons - such as injury to body organs due to insecticide being taken into the body through the mouth or skin</p>

Reading an Insecticide Label

Directions: Look at the label on any product containing insecticide and answer the following questions.

1. What is the common name of the product?

2. What is this product used for?

3. What is the name of the insecticide in this product?

4. What is the active ingredient?

5. What other ingredients does this product contain?

6. What is the formulation type?

7. How is the product applied?

8. What is the recommended dosage?

9. Are there any restrictions on usage?

10. What instructions are given in case of poisoning?

Unit: Entomology

Name _____

Lesson 6: Safe Use of Insecticides

Date _____

Evaluation

Directions: Circle the letter that corresponds to the best answer.

1. What is the most important thing to remember when working with insecticides?
 - a. Wear protective clothing.
 - b. Read and follow label directions.
 - c. Apply insecticides only when needed.
 - d. Work with insecticides away from animals and waterways.

Correct answer is b.

2. Which signal word represents the moderately toxic insecticide category?
 - a. Warning
 - b. Caution
 - c. Danger
 - d. Beware

Correct answer is a.

3. Which of the following is correct?
 - a. The higher the LD number, the greater the insecticide toxicity and the less it takes to kill.
 - b. The lower the LD number, the lower the insecticide toxicity and the more it takes to kill.
 - c. The lower the LD number, the greater the insecticide toxicity and the less it takes to kill.
 - d. The higher the LD number, the greater the insecticide toxicity and the more it takes to kill.

Correct answer is c.

4. What is the most important rule when applying first aid to an insecticide poisoning victim?
 - a. Check for shock symptoms.
 - b. Flood victim and area with water.
 - c. Remove contaminated clothing.
 - d. Act immediately to begin first aid procedures.

Correct answer is d.

5. Why is it important to wear a respiratory device when using insecticides?
- To protect the applicator's eyes from fumes
 - To prevent external poisoning
 - It is not usually important to wear a respiratory device
 - To prevent internal poisoning

Correct answer is d.

6. Which type of certified pesticide applicator's license would most farmers applying insecticides hold?
- Commercial
 - Private
 - Federal
 - General use

Correct answer is b.

7. What agency establishes the guidelines for the disposal of insecticides?
- Environmental Protection Agency
 - Extension Service
 - Department of Natural Resources
 - Federal Insecticide, Fungicide, and Rodenticide Act

Correct answer is a.

8. What does a classification of "restricted use" of an insecticide indicate?
- The insecticide is not likely to harm people, wildlife, and/or the environment when used according to label directions.
 - The insecticide could cause serious injury to people, wildlife, or the environment unless applied by a well-trained and competent insecticide applicator.
 - The applicator does not need to be certified.
 - The insecticide can only be used on certain crops.

Correct answer is b.

9. Which of the following would not be a correct first aid procedure for insecticide poisoning?
- Act as quickly as possible.
 - Without endangering yourself, remove the victim from the contaminated area.
 - Induce vomiting as quickly as possible.
 - Generously flood the affected skin area or eyes with water.

Correct answer is c.

The rest are essay.

Directions: Complete the following short answer question.

10. What is the difference in the two categories of insecticide poisoning: external irritants and internal poisons?

Course	Agricultural Science II
Unit	Entomology
Lesson	Integrated Pest Management
Estimated Time	50 minutes

Student Outcome

Outline an IPM plan.

Learning Objectives

1. Define IPM (Integrated or Insect Pest Management).
2. Describe why IPM is important.
3. Describe what the economic threshold indicates.
4. Identify the steps involved in developing an IPM plan.
5. Describe a crop calendar.

Grade Level Expectations

SC/EC/1/B/09-11/a	SC/EC/1/B/09-11/b	SC/EC/1/C/09-11/b
SC/EC/1/D/09-11/b	SC/EC/3/C/09-11/b	SC/ST/1/B/09-11/a

Resources, Supplies & Equipment, and Supplemental Information

Resources

1. *Entomology* (Student Reference). University of Missouri-Columbia: Instructional Materials Laboratory, 1991.
2. *Entomology Curriculum Enhancement*. University of Missouri-Columbia: Instructional Materials Laboratory, 2003.

Supplemental Information

1. Internet Sites
 - Integrated Pest Management (IPM) Principles. U.S. Environmental Protection Agency. Accessed January 30, 2008, from <http://www.epa.gov/opp00001/factsheets/ipm.htm>.
 - Integrated Pest Management and Missouri's Agriculture. University of Missouri Extension. Accessed January 30, 2008, from <http://extension.missouri.edu/explore/agguides/pests/ipm1003.htm>.
 - Conservation Services Notes: Integrated Pest Management. Missouri Secretary of State. Accessed January 30, 2008, from <http://www.sos.mo.gov/archives/localrecs/conservation/notes/pestmanagement.asp>.

Interest Approach

Students should review the information they have prepared for their individual insects. Have students think about the ways they would control insects if they became a problem.

This lesson will enable students to complete question 14, Outline of an IPM plan, on their Insect Fact Sheet (AS 1, Lesson 3).

Communicate the Learning Objectives

1. Define IPM (Integrated or Insect Pest Management).
2. Describe why IPM is important.
3. Describe what the economic threshold indicates.
4. Identify the steps involved in developing an IPM plan.
5. Describe a crop calendar.

Instructor Directions	Content Outline
Objective 1 <i>Discuss why insect management is an important part of one's life.</i>	Define IPM (Integrated or Insect Pest Management). The letters "IPM" are used to refer to two different programs. The most general program is Integrated Pest Management. If the pest in question is specifically insects, then the letters can stand for Insect Pest Management.
Objective 2 <i>Discuss why IPM is important. Explain what the economic injury level (EIL) is.</i>	Describe why IPM is important. The basic goal in insect pest management is to prevent insect populations from attaining the economic injury level (EIL). The economic injury level is the level of damage insects do to a crop that is equal in value to the cost it requires to use measures that suppress the insects.
Objective 3 <i>Discuss why it is not always necessary to start insect control measures when insects are seen on a crop.</i>	Describe what the economic threshold indicates. The economic threshold indicates the level of damage done by an insect that is used to warn the agriculturalist of potential problems.
Objective 4 <i>List and describe the specific steps in developing an IPM plan.</i>	Identify the steps involved in developing an IPM plan. <ol style="list-style-type: none">1. Identify the problem2. Assess the damage3. Prepare cost/benefit analysis4. Select a management strategy5. Implement the management strategy6. Follow-up on the plan

Instructor Directions	Content Outline
<p>Objective 5</p> <p><i>Discuss why an Integrated Pest Management program begins by focusing on the crop. The different management plan possibilities can be better evaluated by making a crop calendar.</i></p>	<p>Describe a crop calendar.</p> <p>A crop calendar is an outline of the crop's growing season. It provides a systematic and efficient way of looking at the components in a cropping system.</p> <ol style="list-style-type: none"> 1. Set up a table with the 12 months across the top. The left column will indicate crop information such as the following: <ol style="list-style-type: none"> a. Crop growth stages b. Insects (be specific) <ul style="list-style-type: none"> - If different insect stages affect the crop at different times, indicate what stage the insect is in and when it causes damage. - Indicate the period when insects are most likely to be present and when populations are most likely to cause economic damage. c. Tillage operations d. Fertilizer applications e. Herbicide applications f. Harvesting 2. Now, look at the crop calendar to see when each particular insect will most likely cause the most damage. Look at the growth stage of the crop at this time and think about the following questions. <ol style="list-style-type: none"> a. Is the insect attack happening at a critical time in the growth of the crop? b. Will the crop be able to grow out of any damage? c. Can the insect damage be prevented? d. What insect control measures can be used? e. What are the advantages and limitations of each of these methods? f. How much insect control is needed at this time, considering both the growth stage of the crop and the insect's life cycle? g. How will each of the methods affect the rest of the crop calendar? h. How much will it cost? i. When should the selected measures be started? j. What other factors should be considered in selecting a management plan?

Instructor Directions	Content Outline
Application	<p>Other activities:</p> <ol style="list-style-type: none"> 1. Talk to a local producer about what type of pest management plan he or she uses and how it was selected. 2. Look in a local pest management guide book and compare how the economic threshold, damage assessment, economic injury level, and cost-benefit analysis are determined for different crop and insect species.
Closure/Summary	<p>An integrated pest management plan is an efficient and effective way to evaluate the needs and methods of pest control.</p>
Evaluation: Quiz	<p>Answers:</p> <ol style="list-style-type: none"> 1. d 2. b 3. b 4. c 5. a 6. d 7. a 8. c 9. c <p>Note: Part of the evaluation will be the completed IPM plan for the student's individual insect on their Insect Fact Sheet (AS 1, Lesson 3).</p>

Unit: Entomology

Name _____

Lesson 7: Integrated Pest Management

Date _____

Evaluation

Directions: Circle the letter that corresponds to the best answer.

1. What is an IPM program?

- a. A program used to control insects instead of using chemicals.
- b. A program used after insect damage has reduced crop yields.
- c. An effective system used instead of an insect control program.
- d. An efficient system used in developing an insect control program.

Correct answer is d.

2. What term describes the amount of damage insects do to a crop that equals the cost it requires to use measures that suppress the insects?

- a. Damage assessment
- b. Economic injury level
- c. Economic threshold
- d. Cost/benefit analysis

Correct answer is b.

3. How is the economic threshold determined?

- a. By researching public records
- b. By careful sampling on a regular basis
- c. By calling a local extension office
- d. By monitoring costs and expenses

Correct answer is b.

4. Which of the following steps is not a component of an IPM plan?

- a. Identify the problem.
- b. Prepare a cost/benefit analysis.
- c. Get yield estimates from the local extension office.
- d. Select a management strategy.

Correct answer is c.

5. What does “implementing a management strategy” mean?

- a. Actually putting a plan into action and seeing it through to completion.
- b. The actual process of field cultivation.
- c. Securing a loan from the bank for a plan.
- d. Identifying the exact insects which can cause damage.

Correct answer is a.

6. Why is it essential to keep careful records of an IPM plan?

- a. Records are necessary when reporting costs for tax purposes.
- b. Records are necessary when reporting insecticide use to the EPA.
- c. Keeping careful records is not really essential.
- d. Records indicate how well a selected plan is working and how efficient and effective the measures are.

Correct answer is d.

7. Why is a crop calendar used?

- a. It provides a systematic and efficient way of looking at the components in a cropping system.
- b. It provides a systematic and efficient way of selecting an insecticide.
- c. Provided by agricultural supply dealers, it indicates when agricultural practices should be done.
- d. It indicates what crops should be planted to reduce insect attack.

Correct answer is a.

8. How is the information in a crop calendar used?

- a. To select the proper insecticide
- b. To select an appropriate crop to plant
- c. To evaluate a potential problem and make a decision
- d. To determine how effective a crop rotation was

Correct answer is c.

9. How are the “right” control methods selected?

- a. Methods are selected following recommendation calendars provided by local supply dealers.
- b. Correct control methods will fall below the cost-benefit analysis.
- c. There is no “right” or “wrong” choice in selecting control methods.
- d. Any control measure exceeding the economic threshold is considered wrong.

Correct answer is c.

Agricultural Science II

Curriculum Guide: *Entomology*

Unit Objective:

Students will demonstrate an understanding of insects by collecting, classifying, and displaying 30 insects found in Missouri.

Show-Me Standards: 1.8, SC4

References:

Entomology. University of Missouri-Columbia, Instructional Materials Laboratory, 1991.

Field guide for insects (useful for students to classify their collection)

Students will use additional outside sources to complete this activity.

Instructional Strategies/Activities:

- Students will engage in study questions in lessons 1 through 7.
- Students will complete JS 2.1, Making a Killing Jar; JS 2.2, Labeling Insects; JS 2.3, Spreading the Wings of Butterflies and Moths; AS 2.1, Making an Insect Collection; WS 3.1, Insect Fact Sheet; WS 3.2, Insect Orders; and WS 6.1, Reading an Insecticide Label.
- Additional activities that relate to the unit objective can be found under the heading "Other Activities" in the following location: p. III-50.

Performance-Based Assessment:

Students will collect, classify, and mount 30 different insects for display. The collection will be supplemented with an explanation of each insect's name, life cycle, main food source, and control methods.

Assessment will be based on the quantity of insects, presentation of the collection, and overall quality of the explanations.

**Entomology
Instructor Guide**

The instructor should assign the performance-based assessment activity at the beginning of the unit. Students will work toward completing the activity as they progress through the unit lessons. The assessment activity will be due at the completion of the unit.

1. Each student will create an insect collection of 30 insects found in Missouri.
2. As part of the collection, students will provide explanations for each insect.
 - a. The explanations will include the following:
 - Name of the insect
 - Life cycle
 - Main food source
 - Control methods
 - b. Students will need to use outside sources to find their information.
 - c. Students may not use the source information word for word and must provide a complete bibliography of their sources with their collection.
3. For catching, preserving, and mounting instructions, have students refer to Lesson 2 for information.
4. Present students with both scoring guides (A and B) and instruct them to fill out Scoring Guide B with the name of each insect they collect. Have students turn in Scoring Guide B along with their collection and explanations.
5. Assessment will be based on the quantity of insects, presentation of the collection, and overall quality of the explanations.

**Entomology
Student Handout**

1. You will create an insect collection of 30 insects found in Missouri.
2. As part of the collection, you will provide explanations for each insect.
 - a. The explanations will include the following:
 - Name of the insect
 - Life cycle
 - Main food source
 - Control methods
 - b. You will need to use outside sources to find information.
 - c. You may not use the source information word for word and must provide a complete bibliography of the sources with your collection.
3. For catching, preserving, and mounting instructions, refer to Lesson 2 for information.
4. You will be given two scoring guides (A and B) and instructed to fill out Scoring Guide B with the name of each insect you collect. When complete, give Scoring Guide B to your instructor along with your collection and explanations.
5. Assessment will be based on the quantity of insects, presentation of the collection, and overall quality of the explanations.

Agricultural Science II

Entomology Scoring Guide A

Name _____

◆ Page 7 ◆

Assessment Area	Criteria	0 Points	1 Point	2 Points	3 Points	4 Points	Weight	Total
Presentation of Insect Collection	<input type="checkbox"/> Organized <input type="checkbox"/> Neat <input type="checkbox"/> Correct materials used <input type="checkbox"/> Correct display techniques used	0 criteria met	1 criterion met	2 criteria met	3 criteria met	All 4 criteria met	X 5	
Content of Explanations	<input type="checkbox"/> Information for all insects <input type="checkbox"/> Covers all areas required <input type="checkbox"/> Well organized <input type="checkbox"/> Neat	0 criteria met	1 criterion met	2 criteria met	3 criteria met	All 4 criteria met	X 2.5	
Technical Considerations for Explanations	<input type="checkbox"/> Spelling <input type="checkbox"/> Grammar <input type="checkbox"/> Punctuation <input type="checkbox"/> Capitalization	0 criteria met	1 criterion met	2 criteria met	3 criteria met	All 4 criteria met	X 2.5	
TOTAL								/40 pts.
Score from Scoring Guide B								/60 pts.

Final Assessment Total _____/100 pts.

Comments:

**Entomology
Scoring Guide B**

Name: _____

Note to student: Fill out this form with the names of the insects in your collection and return it to the instructor along with your collection and explanations.

Insect Name	Number of Points Given (2 points per insect)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	
26.	
27.	
28.	
29.	
30.	

Total number of insects _____ **Total number of points** _____

