NC STATE UNIVERSITY

Bug Out

LEADER'S GUIDE

Introduction

Bug Out is a series of insect based activities that emphasize experiential, hands-on learning. The goal of Bug Out is to increase understanding and appreciation of insects and to reduce fear of insects. Bug Out also stimulates thinking ability, develops communication skills, and promotes positive social interactions. This will provide a fun, positive learning situation for young people, grades 2 – 5, when you follow the Bug Out lesson plans. Most of these activities are best done during the summer or fall when insects are most common and active out-of-doors.

Materials lists and pre-class preparations are laid out, along with a suggested script. Where appropriate, vocabulary lists, worksheets, and activity sheets are included. You may encourage 4-H'ers to make a Workbook with these pages.

Posters are included as a **.ppt** file for printing a large- scale poster, if you wish. These are used as references during several of the activities. An educational kit containing most of the nonconsumables needed for implementing these lessons is also available.

This is a revision of the previous Bug Out curriculum based on some original material by Susan P. Whitney and R.C. Hillmann. At the beginning of each activity are the purposes of each and the objectives met in the **NC Standard Course of Study** currently in effect for second grade.

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COLLEGE OF AGRICULTURE & LIFE SCIENCES
ACADEMICS ▲ RESEARCH ▲ EXTENSION

4-H - L- 9-12W

Contents

Mystery Bug

PURPOSE → To become familiar with insects through a study of insect body structure and function.

NC STANDARD COURSE OF STUDY OBJECTIVES →

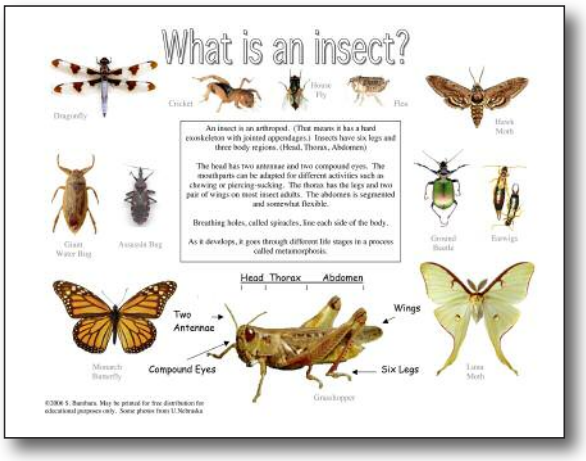
2.L.1.1 Summarize the life cycle of animals including:
- Birth.
- Developing into an adult.
- Reproducing.
- Aging and death.

2.L.1.2 Compare life cycles of other animals such as mealworms, ladybugs, crickets, guppies, or frogs.

LIFE SKILL → Communication – exchange of thoughts, information, or messages between individuals; sending and receiving information using speech, writing, gestures, and artistic expression.

TIME → 30 minutes

MATERIALS YOU'LL NEED →
- Drawing paper and pencils
- Tan (or brown) and black crayons
- One set of the vocabulary list, cover page, and activity sheets for each participant
- "What is an insect?" poster (available in 8.5" x 11"page – or oversized .ppt file)



BEFORE THE CLASS →
- Review the notes on the back of the "What is an insect?" poster
- Practice saying the vocabulary words aloud.

LEAD-IN →

"Today we will draw a Mystery Bug. I won't tell you what kind of insect you are going to draw. Instead, I will describe the insect and you will draw according to my description. So, listen carefully. When you are finished with the drawing, you will know the name of the Mystery Bug!"

PROCEDURE ➛

1. Distribute vocabulary list to each participant (page 27).
2. Draw a Mystery Bug following the script below.
3. Describe honey bee behavior.
4. Discuss insect structures using the "What is an insect?" poster.
5. Label drawings using vocabulary list.
6. Collect Mystery Bug drawings and vocabulary lists for use in Lesson 2.
7. Distribute cover page (page 26) and activity sheets (pages 28–29) for take-home. Participants may color these and begin their Bug Out Workbooks at home.

LEADER'S SCRIPT FOR "MYSTERY BUG" HEAD ➛ "The Mystery Bug has a small, round head. Place your paper sideways. Use about one-fourth of your paper to draw the head. Draw a circle about the size (diameter) of a soda pop can for the Mystery Bug's head. Draw a larger circle behind and touching the head and another still larger circle behind and touching that. These two circles can be a little flat on top and bottom to form an oval shape. You can use all of your paper for these three circles."

"On top of the head (remember that was the first small circle) the Mystery Bug has two long thread-like things. Does anyone know the name of these?"

TYPICAL RESPONSES THAT YOUR STUDENTS MAY GIVE, SOME MAY BE INCORRECT ➛ feelers, antennas, antennae, and sometimes antlers.

"These are called antennae (an ten ee). When they are on your TV they are called antennas, but when they are on an insect they are antennae. Antlers are on much larger animals!"

"'Feelers' is not the best word to call these structures, because they do much more than feel. Antennae also work like insects' noses! This Mystery Bug can smell things with its antennae. What do you think it would like to smell?"

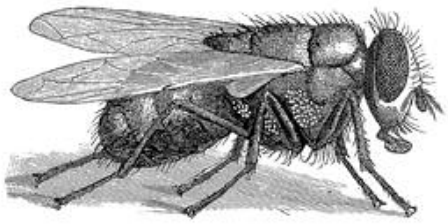
TYPICAL RESPONSES ➛ food, enemies, home, mates, water, air, other animals

"Some insects 'hear' with their antennae, also. They probably don't hear sounds like we do. Most likely they feel vibrations with the fine hairs growing along their antennae. Male mosquitoes sometimes locate their 'girl friends' by 'listening' to their wing beats!"

"The Mystery Bug's mouth is a little strange. It has lips that move up and down, but its jaws move sideways! Do you think you could eat lunch like this?" The leader can hold his/her hands to the face showing how insect jaws protrude and move sideways. Allow participants to draw this.

"Insect jaws are called **mandibles** (man dah bulls). They often have jagged teeth. These are the only teeth that the Mystery Bug has."

"Now we need to give our Mystery Bug some eyes. Can someone describe what the eyes of an insect look like? Think of the eyes of a house fly."



TYPICAL RESPONSES ➛ like a grid, with dots, like graph paper, a honeycomb, or reflecting ball in the ceiling.

"The large eyes of an insect are called compound eyes. They are made of thousands and thousands of tiny eyes all put together side by side to make one picture. What do you think the world would look like if you looked through compound eyes?"

TYPICAL RESPONSES ➔ **Big, I could see all over, I would see the same thing over and over again, I could see a lot.**

"Compound eyes may not see an image as clearly as we do, but they can see movement very well. That is important for a fast-moving insect to catch its food-or avoid being some other animal's dinner! Insects also have simple eyes called ocelli (oc cell eye). These eyes don't see a picture, they only see how bright it is. Put three little circles on top of the head."

Thorax (thor aks): "Behind the head of the Mystery Bug is a large round chest (the second circle you drew), called the thorax. On top of the thorax are wings and on the bottom are legs. Draw four wings on top of the thorax. The wings are medium-sized and do not have color. They are see-through wings like a window. What does an insect do with its wings? Where does it go?"

TYPICAL RESPONSES ➔ **fly to food, avoid enemies, fly home, catch its mate, fly to water**

"On the bottom of the thorax are six legs. Make sure that you draw six! Insect legs can do something special. They can bend. Can you imagine what it would be like if you couldn't bend your arms or legs? How would you eat a peanut butter sandwich? An insect can run fast, catch its food, and run away from enemies because it has jointed legs. Draw six jointed legs."

Abdomen (ab doh men): "Behind the thorax is a large, fat tummy called an abdomen." (optional question) "How long must you hold an insect's head underwater before the insect would drown?" Let the youngsters give you some responses.

CORRECT ANSWER ➔ **It won't drown with only its head underwater.**

"Along both sides of the abdomen and thorax is a row of tiny holes through which an insect breathes. Remember, the Mystery Bug does not have a nose, and it cannot breathe through its mouth. It must use these holes, called **spiracles** (speer ah culls), for breathing. Draw two on the side of the thorax and eight on the side of the abdomen in a single row from front to back."

"The Mystery Bug has a striped abdomen of brown and tan. Do you know what the Mystery Bug is now? What is on the tip of its abdomen? Draw it in."

TYPICAL RESPONSES ➔ **honey bee, bee, wasp, etc.; stinger**

Wasps do a good job by eating a lot of pest insects such as caterpillars and flies.

SOCIAL LIFE OF HONEY BEES ➛

"There are three kinds of honey bees in a colony. The queen is the mother of all the bees and lays the eggs and lives two or more years. The boy bees are called drones. Some mate with a young queen outside the hive. The drones who do not mate die off at the end of the season. All the worker bees are girls.

"Young worker bees feed the baby bees (larvae). Older workers build the honeycomb. The oldest workers visit flowers to gather nectar for honey and pollen for food. They have hairs on their hind legs that look like tiny rakes and hold the pollen for the trip home. These hairs are called pollen baskets. Draw a pollen basket on the hind leg of your Mystery Bug." (The pollen basket could be a bunch of hairs drawn on the hind legs or could include a lump of pollen with the hairs sticking out of it.)

"When the workers return to the hive, some will wiggle and turn in circles to perform the waggle dance which tells the other bees where the best flowers are (see page 30). In the fall the drones are no longer needed so the workers throw them out of the hive."

LET'S TALK ABOUT IT ➛ Show participants the "What is an insect?" poster and discuss the structures of an insect using the notes on the back of the poster. "Now that we've drawn an insect, can you tell me what an insect is? When you turn over a rock and find a little critter, how do you know whether or not it's an insect? Look at your drawings and tell me what makes an insect an insect."

TYPICAL RESPONSES ➛ six jointed legs, three body divisions (head, thorax, and abdomen), wings, compound eyes, ocelli, two antennae, spiracles, jaws that move sideways, small size

(Using the notes on the back of the "What is an insect?" poster, discuss modifications of the basic insect body and adaptations.) "Not every insect that you find will have all of these body parts. Can you think of some insects that do not have wings?"

TYPICAL RESPONSES ➛ fleas, some termites, and ants

"How can a flea get around without wings?"

TYPICAL RESPONSES ➛ "They jump instead."

Participants may label their drawings. Collect the drawings and vocabulary lists for use in Lesson 2, "Let's Look at Insects." Participants may take their cover pages and activity sheets home for their "Bug Out Workbooks."

SUGGESTION ➛ You may wish to expand "Honey Bees" into a separate lesson. Many counties have a beekeeper association and possibly a local beekeeper would conduct the lesson for you. To find your local 4-H agent go to: http://www.ces.ncsu.edu/index_php?page=countycenters

Let's Look at Insects

PURPOSE →
- To build on the concepts of Lesson 1.
- To become familiar with insects through a study of insect body structure and function.

NC STANDARD COURSE OF STUDY OBJECTIVES →

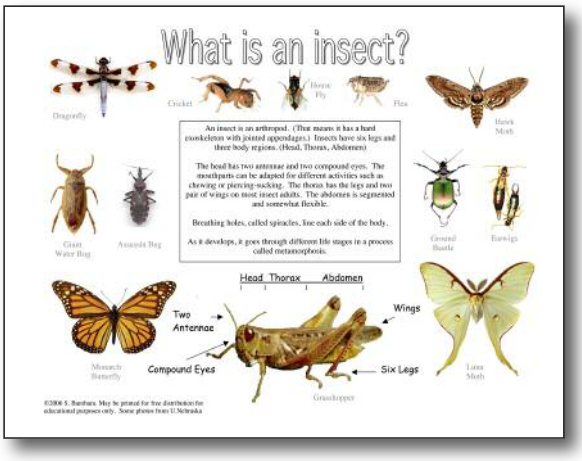
2.L.1.1 Summarize the life cycle of animals including:
- Birth.
- Developing into an adult.
- Reproducing.
- Aging and death.

2.L.1.2 Compare life cycles of other animals such as mealworms, ladybugs, crickets, guppies, or frogs.

LIFE SKILL → Learning to learn – acquiring, evaluating, and using information; understanding the methods and skills for learning

TIME → 30 minutes

MATERIALS YOU'LL NEED →
- "What is an insect?" poster
- A set of worksheets and activity sheets for each participant
- Pencils
- Any real or mounted insects to which you may have access



BEFORE THE CLASS →
- Review the "What is an insect?" poster.
- Review the worksheet questions and answers.
- Gather the Mystery Bug drawings and word list from Lesson 1.

LEAD-IN → "In the last lesson we drew the parts of an insect to form a honey bee. Today we will see these parts on models and real insect specimens."

Return the participants' Mystery Bug drawings and vocabulary lists. If any participant missed the first lesson, display a sample Mystery Bug drawing. Display the "What is an insect?" poster.

"Let's review the insect body parts that we learned during the "Mystery Bug" lesson."

Review vocabulary and definitions. Ask participants to repeat each vocabulary word out loud.

PROCEDURE →

1. Pass out worksheets to each participant (see pages 31–34).
2. Allow the participants to study any real or model insects that you may have.
   Magnifying glasses or 5x to 10x pocket lenses make it more fun, but are not essential.
3. Help participants fill out the worksheets.
4. Review the correct answers as a group using the scripts below.
5. Distribute activity sheets to each participant.
6. Participants may take their Mystery Bug drawings, vocabulary list, worksheets, and activity sheets home for their workbook.

The "What is an insect?" poster shows a butterfly, beetle, fly, and a cricket. Participants will see all the major structures of a typical insect (page 31). The answers to the worksheet are:

1. 4
2. 2
3. 2
4. compound
5. six
6. jump (hop)
7. three
8. head, thorax, abdomen
9. thorax
10. smell

LEADER'S SCRIPT FOR "LET'S LOOK AT INSECTS" → (After the participants have observed the demonstrations, hold up the "What is an insect?" poster.) "Did everyone see the wings of the butterfly? What color are they? How many wings does the butterfly have?"

CORRECT ANSWER #1 → four wings

"There are two wings in the front and two in the back. The wings are covered with colorful scales that will rub off if you touch the butterfly. Did everyone write "4" for question #1?"

"Did someone count the antennae on the butterfly? How many antennae are there?"

CORRECT ANSWER #2 → two

(Point to the picture or model of the fly.) "Where do you find flies?"

TYPICAL RESPONSES → On windowsills and garbage, around farm animals

"Can someone tell me the answer to question 3? How many wings does a fly have?"

CORRECT ANSWER #3 ➔ two wings

"Did everyone see the eyes of the fly? What did they look like?"

TYPICAL RESPONSES ➔ like a grid, with dots, like graph paper, a honeycomb, mirror ball in the ceiling of a roller rink, red.

"Are insect eyes made like your eyes? Do they have a single large hole (pupil)?"

CORRECT ANSWER #4 ➔ No. No. They are called compound eyes (which means a lot of parts together as one)

(Hold up the cricket or grasshopper or point to the picture.) "How many of you have caught crickets or grasshoppers? Where?"

TYPICAL RESPONSES ➔ in fields, in weeds, in the house, in barns

"How many legs do you see on the cricket or grasshopper? What kind of legs are they?"

CORRECT ANSWER #5 ➔ six jointed legs

"What does the cricket or grasshopper do with its hind legs?"

CORRECT ANSWER #6 ➔ jumps, hops

(Point to the ground beetle picture.) "Can you see the body parts of the ground beetle? How many are there? What are they called?"

CORRECT ANSWERS #7 AND #8 ➔ three body divisions-head, thorax, and abdomen.

"To which body section are the legs and wings always attached?"

CORRECT ANSWER #9 ➔ thorax

"Does a beetle have a nose?"

TYPICAL RESPONSES ➔ no

" What does the luna moth do with its antennae?"

CORRECT ANSWER #10 ➔ smell, feel, touch

Do insect bodies look hard and stiff? They are – because their skeletons are on the outside. Where is your skeleton? (on the inside). Insects are kind of inside-out from us and have exoskeletons (exo = outer) on the outside. That seems clumsy for something as big as us, but works well for something as small as an insect.

LET'S TALK ABOUT IT ➛ "Point to each structure on your Mystery Bug drawing and show me the same parts on the insect poster."

"What is the name of each structure? What does the structure do and how does it work?"

Participants may take their Mystery Bug drawings, vocabulary list, worksheets, and activity sheets home for their Bug Out Workbooks.

OTHER ACTIVITIES ➛

1. Participants may role play the workers, drones, and queen in a beehive.
2. Participants may invent a "waggle dance" (see drawings on page 30).
   a. The round dance is done when food is within 100 meters (yards) of the hive. The worker bee takes short steps in circles that change direction.
   b. The wag-tail dance is done when food is beyond 100 meters (yards). The worker bee dances a half circle and runs in a straight line to the starting point. While she runs the straight line, she wiggles vigorously. She then dances a half circle on the other side with a second run to the starting point.
3. Participants like to talk about insects that they have seen. Ask them.

A honey bee moves its wings 11,000 times per minute when flying.

How Do They Grow?

PURPOSE

- To understand insect growth and development.
- To learn to recognize and name the growth stages of insects.

NC STANDARD COURSE OF STUDY OBJECTIVES

2.L.1.1 Summarize the life cycle of animals including:
- Birth.
- Developing into an adult.
- Reproducing.
- Aging and death.

2.L.1.2 Compare life cycles of other animals such as mealworms, ladybugs, crickets, guppies, or frogs.

LIFE SKILL

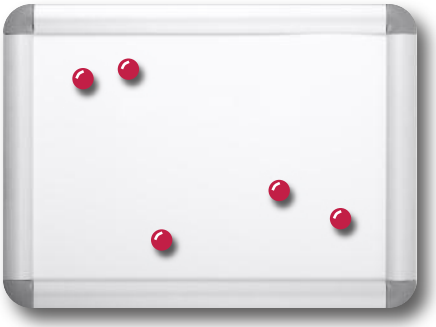
Learning to learn – acquiring, evaluating, and using information; understanding the methods and skills for learning

TIME

30-45 minutes

MATERIALS YOU'LL NEED

- "How Do They Grow?" magnet/display board directions (pages 39–45)
- Posters: "What is an insect?" "Simple Metamorphosis" and "Complete Metamorphosis" (pages 23–25)
- Copies of the vocabulary matching list (page 35) and Meal Moth life stages for each participant (page 38)
- Two paper plates and one brass brad for each participant
- Scissors, crayons (or markers or colored pencils)



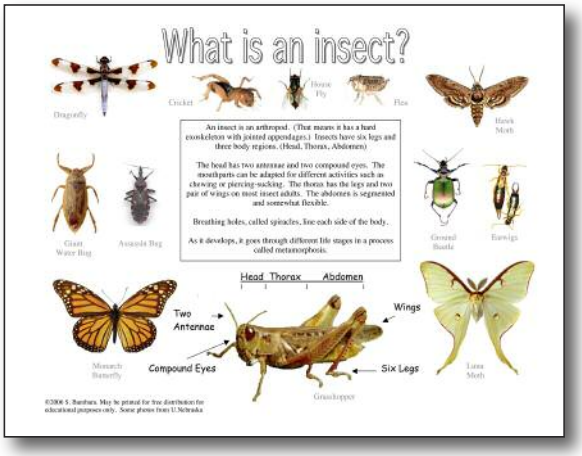
BEFORE THE CLASS

- The volunteer club leader should make arrangements to use or make the "How Do They Grow?" display board.
- Practice using the magnet board.
- Make one life cycle wheel to use as a model. (See "Making Life Cycle Wheel" pages 36–37)
- Review the vocabulary matching list and practice pronouncing singular and plural forms (larva/larvae, pupa/pupae).

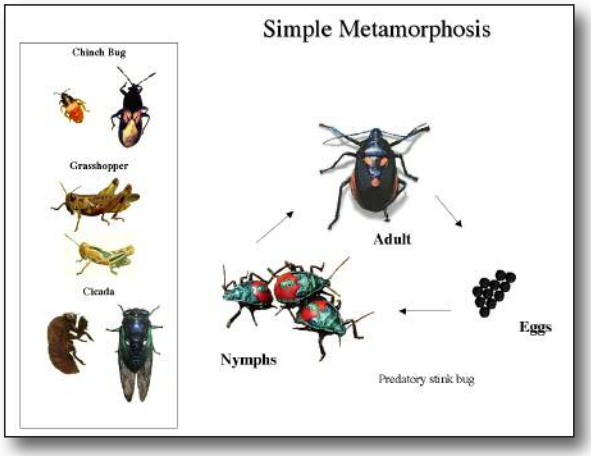
LEAD-IN

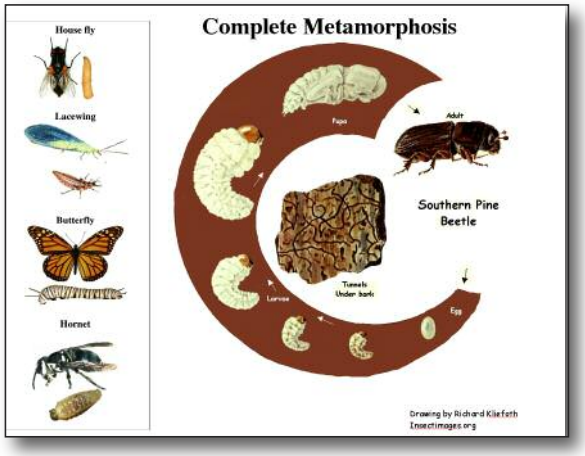
"How many of you have found a caterpillar, inchworm, or larva? What did it look like? What was it doing? Did you know that a caterpillar is a baby insect? We are going to find out how insects grow and turn into adults today."

PROCEDURE ➛ 1. Distribute vocabulary matching lists to each participant (page 35).
2. Display "What is an insect?" poster (page 23).



3. Discuss insect growth and development using the magnet/display board (pages 39–45) and the script below.
4. Display "Simple Metamorphosis" and "Complete Metamorphosis" posters (pages 24–25).





5. Review types of metamorphosis and examples.
6. Collect vocabulary matching lists for use in Lesson 5, "Let's Look at More Insects."
7. Construct Life Cycle Wheels (pages 36–37).
8. Encourage participants to take their Life Cycle Wheel home to show family and friends.

LEADER'S SCRIPT FOR "HOW DO THEY GROW" ➛ "Insects have skins that look very different from ours. Can someone describe the outside of an insect? Think of a big beetle."

TYPICAL RESPONSES ➛ **hard, dark, looks like a shell**

"That is right. The outside of an insect is called an **exoskeleton** (exo skeleton). That is the first word on your vocabulary matching list. The first three letters of this word, -exo-, mean 'outer.' The exoskeleton is a non-living shell that completely surrounds the insect."

"The end of the word exoskeleton, -skeleton-, means 'supporting framework.' What is the supporting framework for our bodies?"

TYPICAL RESPONSES ➛ **bones**

"Do you know that insects do not have bones inside their bodies? This shell, the exoskeleton, takes the place of bones. Muscles are attached to it from the inside. We have our bones on the inside of our bodies, and an insect has its exoskeleton on the outside – so an insect is turned inside out! Do you think this is a good idea to have your 'bones' on the outside?"

TYPICAL RESPONSES ➔ Yes, it gives protection and makes the insect hard to hurt. No, if they broke their shell, it might hurt them.

"The exoskeleton does protect the insect and it waterproofs it, too! I wonder if you've ever found an exoskeleton. How many of you have found a **cicada** (sa kay dah) skin?" (Locust is an often used but incorrect name.) "Tell me what the cicada skin looked like."

TYPICAL RESPONSES ➔ brown, see-through, tan, crunchy, crumbly, fell apart, had claws, stuck to me

Point out the cicada exoskeleton picture on the Simple Metamorphosis Poster. "Where did you find them?"

TYPICAL RESPONSES ➔ saw them on the side of the house, a brick building, on a tree trunk, on the ground

"Did you see a slit down the back of the cicada skin?"

TYPICAL RESPONSES ➔ yes

(Place cicada egg and labels 'cicada' and 'egg' on the display board.) "Let's see how insects like the cicada grow up. The cicada begins life as an egg."

Place cicada nymph and label 'nymph' on magnet/display board. Then place arrow on the display board between the egg and nymph.) "When the egg hatches, the baby cicada that comes out looks a little like the adult. It has legs, three body divisions, compound eyes, and antennae. The baby cicada is called a **nymph** (nimf). It lives underground and feeds on tree roots. The nymph eats and eats and eats until it is ready to grow bigger but cannot. It can't—because its shell, the exoskeleton, won't stretch or grow."

"So it takes in a big gulp of air. Everyone pretend to be an insect and take in a big gulp of air. Breathe in deeply. What do you feel? Does your chest get big? When a nymph pumps up its chest, it splits the skin down its back – and crawls out!"

"This is called molting, or shedding the skin. Do you know another animal that sheds its skin?

TYPICAL RESPONSES ➔ snakes

"The new exoskeleton underneath will soon harden and be bigger than the old. But it does not stretch too far and will not grow with the nymph. So one day it, too, will be shed. The periodical cicada nymph molts up to 35 times over 17 years! The more common annual cicada only takes a year or two to grow up and it doesn't molt as often. As they grow, wing pads appear. The wing pads can't be used to fly yet; they are too small."

(Place adult and label 'adult' on display board. Then place arrow between the nymph and adult.) "The last time that the nymph molts, it crawls out of the ground, sheds its skin, becomes an adult, spreads its wings and flies away."

(Place label 'simple metamorphosis' on display board.) "Insects that grow this way have simple **metamorphosis** (met ah mor fo sis). Do you know what metamorphosis means?"

PARTICIPANTS MAY NEED HELP WITH THE RESPONSE ➔ change in form during growth

(Display the "What is an insect?" poster. Review characteristics of an insect using the new terms "exoskeleton" and "growth by molting.")

(In new area of magnet/display board, begin...) "Some insects grow a different way."

(Place butterfly egg and labels 'butterfly' and 'egg' on display board.) "The butterfly also begins life as an egg."

(Place larva and label 'larva' on display board. Then, place arrow between egg and larva.) "When the egg hatches, the baby insect that comes out doesn't look anything like the adult. This kind of baby insect is called a **larva** (lar vah). The larva eats, molts, and grows, and eats, molts, and grows."

(Place pupa and label 'pupa' on display board; place arrow between larva and pupa.) "When it is done eating, it curls up and forms a case around it. Inside the case larva molts one more time. Now it is called a **pupa** (pew pa)."

"Some **larvae** (lar vee) may spin silk cases around themselves before they form **pupae** (pew pee). The case is called a **cocoon** (ka coon). The pupa may look dead because it does not crawl around, but there is a lot going on inside of it. Inside, the wings are growing bigger each day. The compound eyes are growing, too. What else do you think is growing inside the pupa?"

TYPICAL RESPONSES ➔ jointed legs, antennae, ocelli, three pairs of mouthparts

(Place adult and label 'adult' on display board; place arrow between pupa and adult.) "Soon the case will open, a butterfly will come out, spread its wings, and fly away."

(Place label 'complete metamorphosis' on display board.) "Insects that grow this way have complete metamorphosis."

"We can make a life cycle wheel of complete metamorphosis to take home. I will show you how."

LET'S TALK ABOUT IT ➔ (Display the poster "Simple Metamorphosis.") "These insects have simple metamorphosis. How many of them have you seen? Where? What were they doing?"

(Display the poster "Complete Metamorphosis.") "These insects have complete metamorphosis. How many of them have you seen? Where? What were they doing?"

"Have you found **larvae** (lar vee) or **pupae** (pew pee) before? Has anyone seen a nymph? Where? What did the nymph look like? What were they doing? Look for some larvae, pupae, and nymphs before our next meeting."

Bugs in a Bottle

PURPOSE →
- To make a chamber so children can observe live insect behavior at home.
- To familiarize children with living insects over an extended period of time.

NC STANDARD COURSE OF STUDY OBJECTIVES →

L.2.1.1 Summarize the life cyle of animals including
- Birth
- Developing into an adult
- Reproducing
- Aging and death

L.2.1.2 Compare the life cycles of other animals such as, but not limited to, mealworms, ladybugs, crickets, guppies, or frogs.

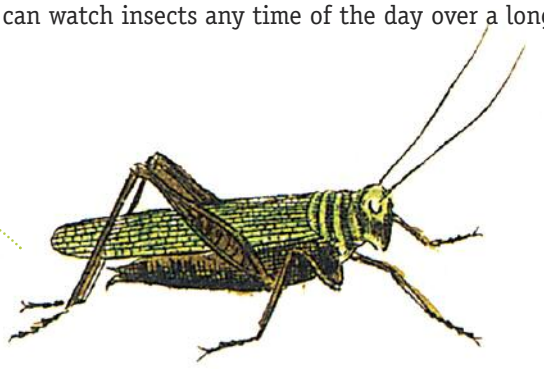
LIFE SKILL → Learning to learn – acquiring, evaluating, and using information; understanding the methods and skills for learning

TIME → 30 minutes

MATERIALS YOU'LL NEED →
- Empty, two-piece plastic soda bottles, 3-liter size preferred; one for each group of five
- Round section of turf containing clover, about 4 inches in diameter
- Scissors
- Trowel or small shovel
- One or two crickets, grasshoppers, or other type of insect for the demonstration, per bottle. Crickets may be easily purchased from a bait shop.

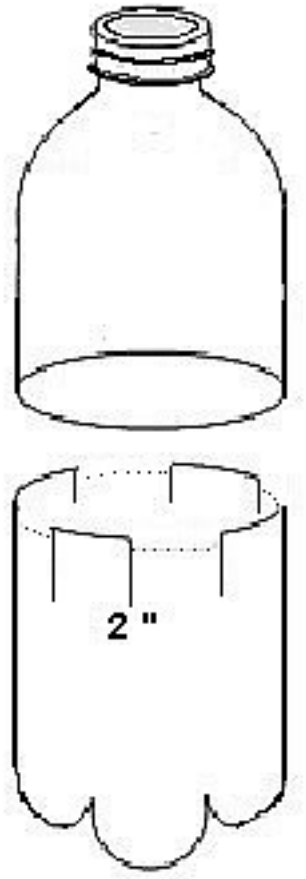
BEFORE THE CLASS →
- Dig a piece of turf that contains some clover from a lawn. Be sure to include the soil covering the roots. This may be kept in a plastic bag in the refrigerator for several days. Plants such as beans, which could be started from seed a week or two ahead, may be used as an alternative to turf.
- Prepare one bug bottle as described below for demonstration.
- Transplant turf piece into empty bottle base. Cover with inverted bottle. Add crickets to make demonstration bug bottle.
- Catch common insects, such as crickets, grasshoppers, or caterpillars (or buy crickets from a bait shop). If you find a caterpillar, collect the plant or part of the plant on which you found it.

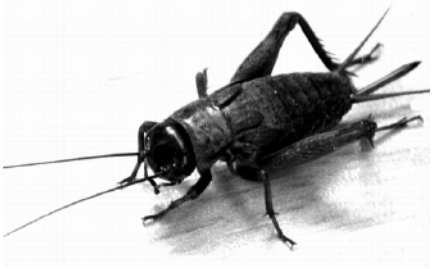
LEAD-IN → "We don't often have a chance to observe living insects for more than a few moments at a time or during more than one type of activity. Today we are going to build an insect observation chamber so we can watch insects any time of the day over a long period of time."



PROCEDURE ➔

1. Cut a 2- or 3-liter soft drink bottle in half.
2. Make eight parallel cuts around the edge of the open end of the bottom section, spaced evenly apart and about 2 inches long to form a series of tabs. Cut alternating tabs off about 1/2 inch so that every other tab is slightly shorter (see figure).
3. Place your turf plug or plant in the colored plastic base. Turn the clear cylindrical portion down over the base, sliding alternate tabs inside and outside the rim.
4. The bug bottle is ready for your insects. Place them in through the top of the bottle.
5. Your bug observation chamber will probably not need water often. If it does, a little may be dripped in through the top.
6. To change plants or add food, put the bug bottle in the refrigerator about 30 minutes. After the insects have stopped moving, the bottle may be opened and the plants or turf changed. As the insects warm up, they will become active again.
7. Do not let sunlight shine directly on the bottle and do not leave it in a car.





LET'S TALK ABOUT IT ➛ "What kind of insects are you going to put in your bug home? How many of you have ever caught crickets? Where did you find them? Tell me where you are going to look for insects for your bug home. Some good places are old weedy fields. Look for grasshoppers in roadside ditches and weedy patches on the edges of gardens, especially in late summer. Gardens and flower beds are good places, too."

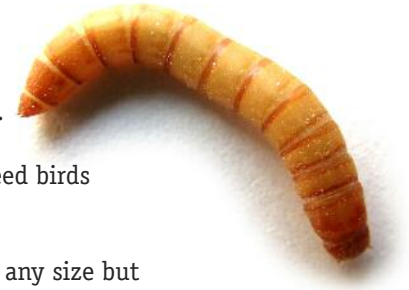
"What do you think you will see the insects do? Will they eat? Will they sleep? Tell me what you are going to look for when you watch your insects in their bug home."

"What would happen if you put a caterpillar in a bug bottle? Do you think it might pupate? Then what would happen? Yes, it would become a butterfly or moth!"

"Can you think of some experiments that you could do with several bug homes? What about using different plants or different insects? Could you put your bug bottles in different environments? In different temperatures?"

"If you want to change the clover, place your bug bottle in the refrigerator for about 30 minutes (ask your parents first). After the insects have stopped moving, dismantle the bug bottle, place it over another container of fresh clover and return the insects to their new home. They will become active again in a few minutes."

"You wouldn't want to let the sunlight shine directly on the bug bottle or leave it in a hot car. Do you know why? That's right. It would get so hot that your bugs would die."



RAISING MEALWORMS ➛ In addition to your "Bugs in a Bottle," you can also raise mealworms! You can do this along with your bug bottle activity or any time.

Raising mealworms is easy and fun. They can also be used for fishing bait or to feed birds or reptiles after your observations.

Use any container such as a disposable plastic storage container. It can be almost any size but should have a little depth. Fill it with oat bran or oatmeal about 1 inch in depth. Purchase some mealworms from a pet store for a few dollars. Be sure to tell them that you want *Tenebrio* and not "Giant mealworms."

Place the mealworms on the layer of bran or oats. You can add a little shredded paper on the surface for the adults to crawl on and hide under, if you wish. Add a baby carrot every three or so weeks for moisture. Punch a few holes in the lid and close the container. Set it aside in a safe place out of direct sunlight. Larvae develop depending upon temperature. You will want to keep your colony at least 4-6 weeks. Keep a record of the temperature and the number of days it takes for each life stage. If you want to keep the colony going on a longer term, set up a second container with oats and move pupae and adults to the new container to mate and lay more eggs. You can then go back and forth with the two containers.

OTHER ACTIVITIES ➛ "Take an insect-collecting hike through a park or garden or your own yard. Collect insects in wide-mouth jars, such as peanut butter jars. Put the jars in the refrigerator until the insects are cool and can be more easily placed in the bug bottle. Caterpillars are sometimes found feeding on the leaves of trees and shrubs. If you collect a feeding caterpillar, add leaves from the plant on which it was feeding. If the caterpillars feed and pupate, you may see the adult come out of the cocoon." (Some pupae require a few months of cold temperature before the adult will emerge.)

Participants may keep records of field trips and their insect's activity at different times of the day in their workbook.

LESSON 5

It's a Bug's Life - Observations

PURPOSE →
- To learn how to make observations of live insects using a bug bottle.

NC STANDARD COURSE OF STUDY OBJECTIVES →

L.2.1.1 Summarize the life cyle of animals including
- Birth
- Developing into an adult
- Reproducing
- Aging and death

L.2.1.2 Compare the life cycles of other animals such as, but not limited to, mealworms, ladybugs, crickets, guppies, or frogs.

LIFE SKILL → Learning to learn – acquiring, evaluating, and using information; understanding the methods and skills for learning

TIME → 30 minutes

MATERIALS YOU'LL NEED →
- Five bug bottles with live insects and plants for observation exercise.
- Three (or four) copies of observation sheet for each participant
- Pencils

BEFORE THE CLASS → Set up five bug bottles for the observation exercise. See Lesson 4 for directions. You will want at least one bug bottle for every five participants. Use a variety of insect and plant species. Grasshoppers, crickets, aphids on a stem, caterpillars and larvae from gardens or crops, and lady beetles are good choices. Use your porch light at night to attract different beetles. In the summer, predatory green lace wings are abundant at porch lights. Clover, grass, and weeds are good food plants.

LEAD-IN →

Scientists have many questions about insects. They often answer these questions by making careful observations. We can learn how to make scientific observations by using bug bottles (hold up bottle). We need to learn how to understand what insects do so that we can conduct more useful studies of insects. The more we understand, the more we can benefit or the better we can deal with problems related to insects in our lives."

PROCEDURE →

1. Place several bug bottles with assorted insects and plants around the room. Place lady beetles and aphids on a stem in the same bottle, and lace wings and aphids in another, also together. A praying mantis likes to catch flies or moving insects. Grasshoppers or crickets are fun to watch while they eat plant leaves.
2. Allow the participants to look at the bug bottle for 5 to 10 minutes, and then assign each participant to a group to make observations. Tell the participants that they can rotate to another station after 5 to 10 minutes. (They will learn more.)
3. Give each participant three observation sheets (page 46).
4. Review the questions on the observation sheets before the participants begin work. Make sure that each participant understands the questions.
5. Use the script below to help participants share their observations with the class.

LEADER'S SCRIPT ➔ "Did any of your insects eat while you were watching them? What did it look like? How did they eat? What did you write for answers to questions 2, 3, and 4?"

TYPICAL RESPONSES ➔ They ate just a little, they moved their heads from side to side, they took bites out of the leaves, they held the leaves with their front legs, they ate one row on the leaf and they swung their heads back and started eating another row.

"Some of your insects ate plants. What part of the plant did the insect eat? What is your answer to question 5?"

TYPICAL RESPONSES DEPENDING ON INSECT ➔ leaves, stems

"How much of the plant did the insects eat? What is your answer to question 6?"

"Who would like to read his/her answer to question 7? Who wrote something to describe how the insects ate?"

"Did any of your insects move while you watched them? How many ran? How many jumped? How many crawled? Who would like to read his or her answer to question 8 and question 9? Who wrote a sentence to describe how the insect moved?"

"Did anyone see the insects doing anything else? Did anyone write an answer for question 10?"

TYPICAL RESPONSES ➔ the insects laid eggs, mated, fought, molted, played, sat

"How does each of these insects avoid being eaten by another insect? What do you have for question 11?"

TYPICAL RESPONSES ➔ they hide, sit still, fly away, look scary, look like the plant

"You may make more insect observations at home with your bug bottle after you fill it with your favorite insects."

Participants may take their observation sheet home for their workbooks.

Lady beetles (also called ladybugs) are very important because they eat many aphid and scale insect pests that damage crops.

LESSON 6

Bug Parts Bingo

PURPOSE → To become familiar with insect body structure and vocabulary.

NC STANDARD COURSE OF STUDY OBJECTIVES →

L.2.1.1 Summarize the life cyle of animals including
- Birth
- Developing into an adult
- Reproducing
- Aging and death

L.2.1.2 Compare the life cycles of other animals such as, but not limited to, mealworms, ladybugs, crickets, guppies, or frogs.

LIFE SKILL → Learning to learn – acquiring, evaluating, and using information; understanding the methods and skills for learning

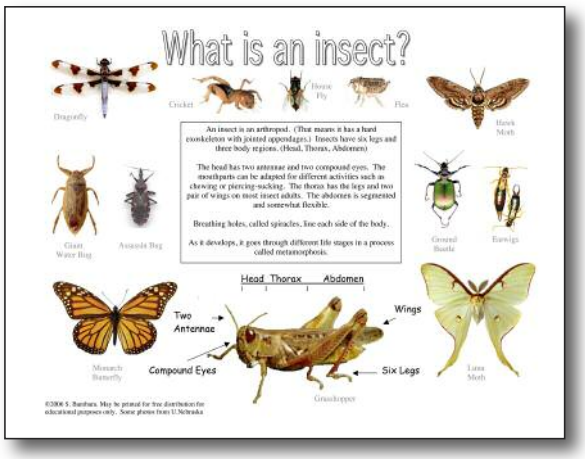
TIME → 30-40 minutes

MATERIALS YOU'LL NEED →
- One copy of the blank Bingo card for each 4-H'er (page 49).
- Scissors for each 4-H'er
- Several glue sticks
- One copy of the labeled "Parts of a Grasshopper" for each 4-H'er (page 48).
- One copy of the Bingo Word definitions cut up into individual strips of paper with one definition per strip (page 47).
- A box or hat from which to pull out the words.

BEFORE THE CLASS → Cut up enough squares of colored paper to cover Bingo squares for each player (about 15 each). You could substitute beans, buttons or pasta.

LEAD-IN → "Who has ever played Bingo before? How did you play it? Today we are going to play a game of Bingo, using the insect body part names instead of numbers."

PROCEDURE → Show or post the poster "What is an insect?"



PROCEDURE (continued) ➔

Give each 4-H'er a copy of the Bug Parts Bingo Card from page 49. Give them a copy of the diagram Parts of a Grasshopper (page 48). Read through the Bingo words one at a time and have them find the picture corresponding to each item on their card. You could also have the 4-H'ers take turns reading a definition. Make sure they understand what has been read.

When you have gone through all the definitions, have the group cut up each square of the grid diagram. (Note there are four unused blank squares. These shaded squares should be discarded.) They may then glue each square in arbitrary places in the open boxes so that each 4-H'er will have a unique card.

When everyone has finished making his/her card, you are ready to start the Bingo game. Pass out the Bingo cover pieces of construction paper or whatever you are using.

Use the cut up strips of the words and definitions and pick them at random from a container one at a time. Call out the words arbitrarily until someone has five squares filled in a row in any direction and yells "Bingo." Check to see that all the squares were really called. The center grasshopper square is a free space.

Play two or three times, or more!

LET'S TALK ABOUT IT ➔

What do you think is the most outstanding feature of a grasshopper?

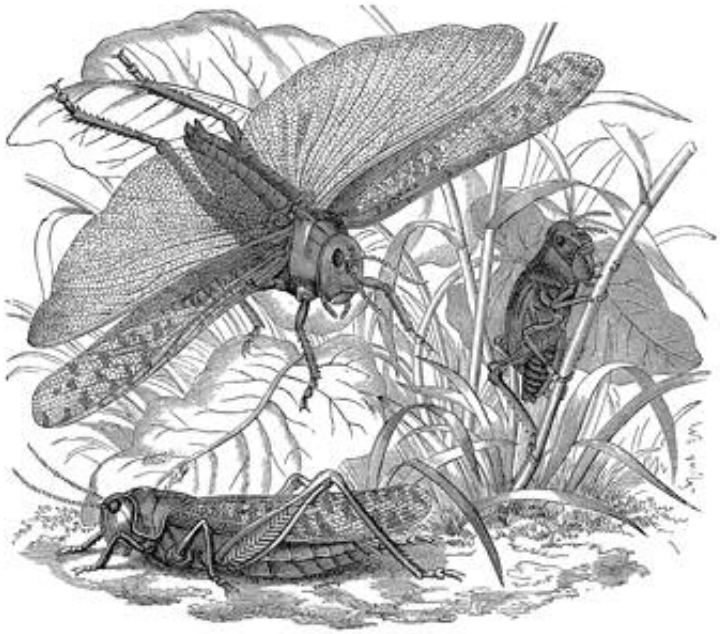
What parts are on a grasshopper that people don't have?

Where are the breathing holes on the grasshopper? Do you think a grasshopper can hold its breath?

Do you like grasshoppers? Are they good or bad insects?

If you found a grasshopper in your house, what would you do?

Do you know any famous grasshopper characters? (Hopper from "It's a Bug's Life" or Jiminy Cricket, perhaps. Grasshopper from "Kung Fu" or "James and the Giant Peach")



What is an insect?

Dragonfly

Cricket

House Fly

Flea

Hawk Moth

Giant Water Bug

Assassin Bug

An insect is an arthropod. (That means it has a hard exoskeleton with jointed appendages.) Insects have six legs and three body regions. (Head, Thorax, Abdomen)

The head has two antennae and two compound eyes. The mouthparts can be adapted for different activities such as chewing or piercing-sucking. The thorax has the legs and two pair of wings on most insect adults. The abdomen is segmented and somewhat flexible.

Breathing holes, called spiracles, line each side of the body.

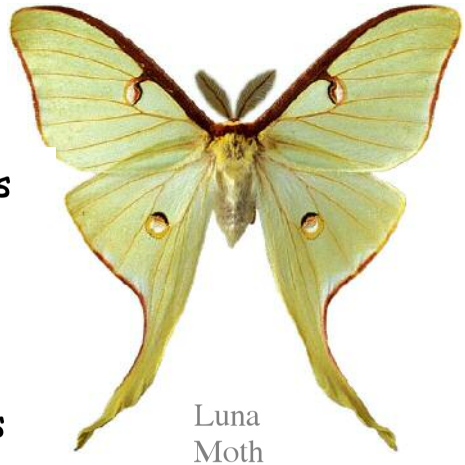
As it develops, it goes through different life stages in a process called metamorphosis.

Ground Beetle

Earwigs

Monarch Butterfly

Grasshopper



Luna Moth

What is an insect?

Illustrated on Poster: grasshopper (diagram), dragonfly, cricket, fly, flea, hawk moth, giant water bug, assassin bug, ground beetle, earwigs, monarch butterfly, luna moth.

BODY DIVISIONS
Insects have three body divisions: head, thorax (thor ax) and abdomen (ab doe men). Each body division is subdivided into segments usually seen as vertical grooves along the body.

LEGS
Insects have six jointed legs on the thorax. Each leg has five segments. Legs may be adapted for leaping (grasshopper), digging (mole cricket), grasping (giant water bug), running (ground beetle), swimming (water bug). Larvae of some beetles, bees and flies are legless. Some caterpillars have prolegs (fleshy body projections used in walking) on the abdomen.

WINGS
The thorax of adult winged insects has two (or sometimes one) pairs of wings. Wings are leathery (grasshoppers), hard (beetles), or clear (dragonflies). True flies have only one pair of clear wings. Some insects are wingless: fleas; certain generations of aphids, termites, and ants; some species of cockroaches; and crickets.

ANTENNAE (an ten ee) [plural]
Adult insects have two antennae that are used to smell, taste, and "hear" (feel vibrations). Insects locate mates, enemies, food, and homes with chemical receptors and hairs on the antennae. Other organs of hearing, thin membranes that vibrate like eardrums, are never on the head; rather, they are on legs (crickets) or the abdomen (cicadas and grasshoppers). Some insects make noises by rubbing parts of their bodies together.

EYES
Compound eyes are made of numerous individual lenses through which the insect sees a pattern in color, black, and white. Ocelli (oh cell eye), simple eyes, usually three on top of the head, distinguish only light and dark. Most adults and nymphs have compound eyes and ocelli; larvae have only ocelli.

MOUTH PARTS
Insects that chew have one pair of "lips" that moves up and down, one pair that moves sideways, and a pair of jaws that also moves sideways. The lips guide food into the mouth. The jaws hold and chew food. In those insects that do not chew, these structures are modified and hollow for piercing and sucking (assassin bugs, aphids, fleas), sponging (house flies) and sucking like a straw (butterflies and moths).

SPIRACLES (speer ah culls)
Insects do not have noses or lungs. Air enters spiracles, holes on the sides of the thorax and abdomen. A network of tubes, tracheae (tray key ee), carry this air throughout the insect body to every cell. Insect blood does not carry oxygen or carbon dioxide. This is why insect blood is clear instead of red like ours. Insects are cold blooded and are usually about the temperature of their surroundings.

EXOSKELETON (x o skel e ton) Grow by Molting
Insects have an external (outside) skeleton instead of bones inside. This exoskeleton is lighter and stronger than bones, provides a place to attach muscles, protects, waterproofs, and supports and provides shape. Because it is a hard, nonliving shell, it cannot grow. Instead, it must be shed at different times to allow the immature insect a short time period to grow [see Lesson "How Do They Grow?"]. Soft membranes between the hard plates of exoskeleton allow an insect to move.

SIZE, SHAPE, AND COLOR
Insects range from 1 mm [4/100ths of an inch] (fairy flies) to 10 cm [4 inches] (goliath beetle). Their small size, ability to lay many eggs, and a short life cycle make insects a highly successful group. Insects exhibit a variety of shapes. Some mimic sticks (walkingstick, geometrid moth larvae), dead leaves (angle wing butterfly), green leaves (katydid), thorns (treehopper), or bird droppings (some leaf beetles). Insects come in all colors, metallic patterns, and iridescent hues. Some are conspicuous; other blend with their backgrounds.

Simple Metamorphosis

Chinch Bug

Grasshopper

Cicada

Adult

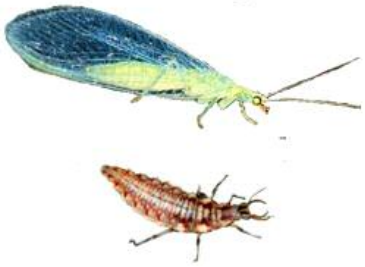
Nymphs

Eggs

Predatory stink bug

House fly

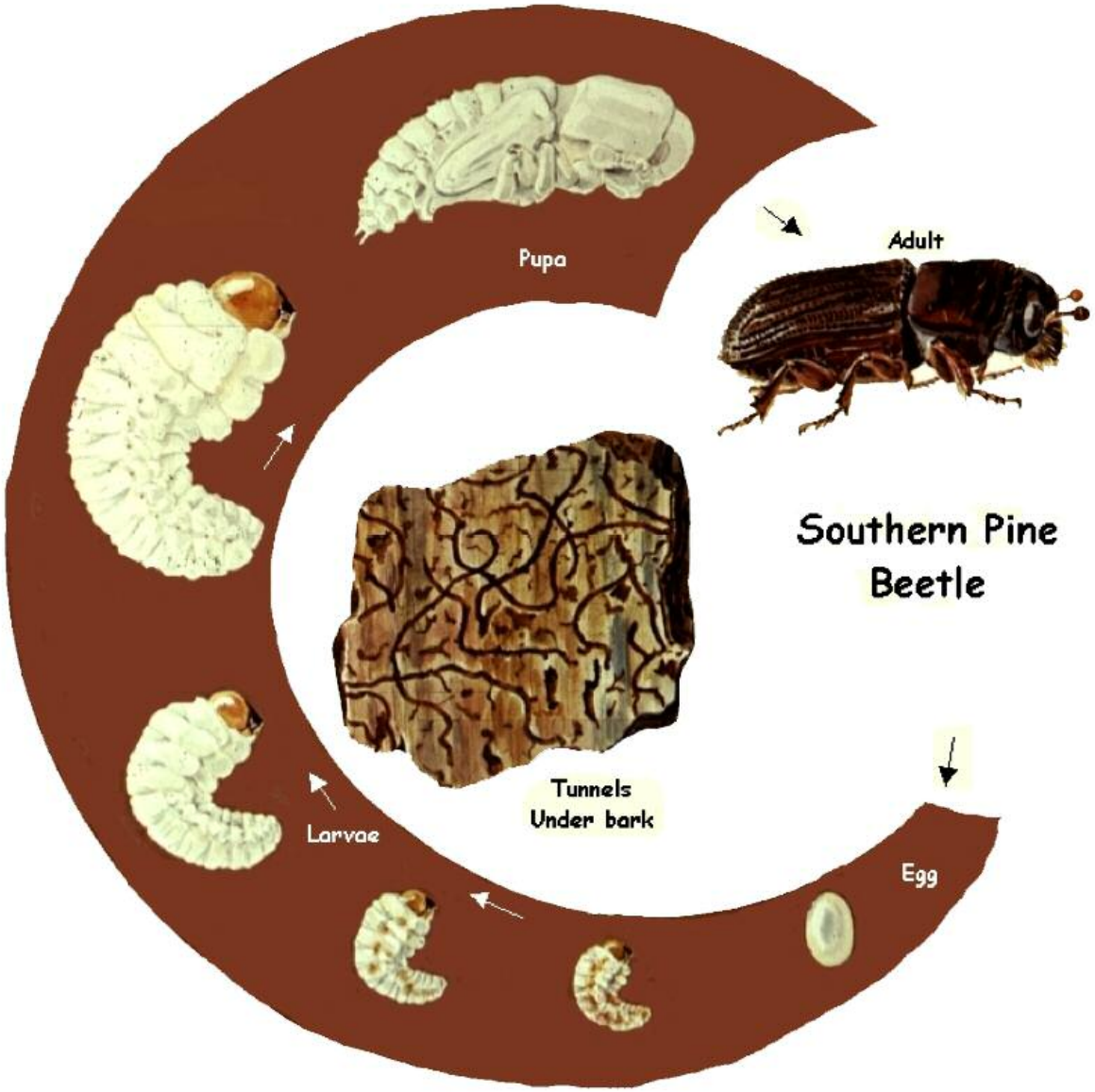
Lacewing



Butterfly

Hornet

Complete Metamorphosis



Drawing by Richard Kliefoth
Insectimages.org

Bug Out → Student Workbook

Name _____

Name _____

LESSON 1

Mystery Bug → Vocabulary Matching

→ Connect the words in the left column to the correct definition among the balloons on the right. Can you use any of the words in a sentence?

head

antennae

mandibles

compound eyes

ocelli

abdomen

wings

jointed legs

spiracles

nectar

The long thread-like parts used for touching and smelling

The part of the body where the mouth and eyes are

The tail end part of the body

Large eyes used for seeing

Insect jaws

The flat, paper-like part used for flying

The sugary solution found in flowers that bees collect to make honey.

The three tiny eye spots on the face used to tell brightness

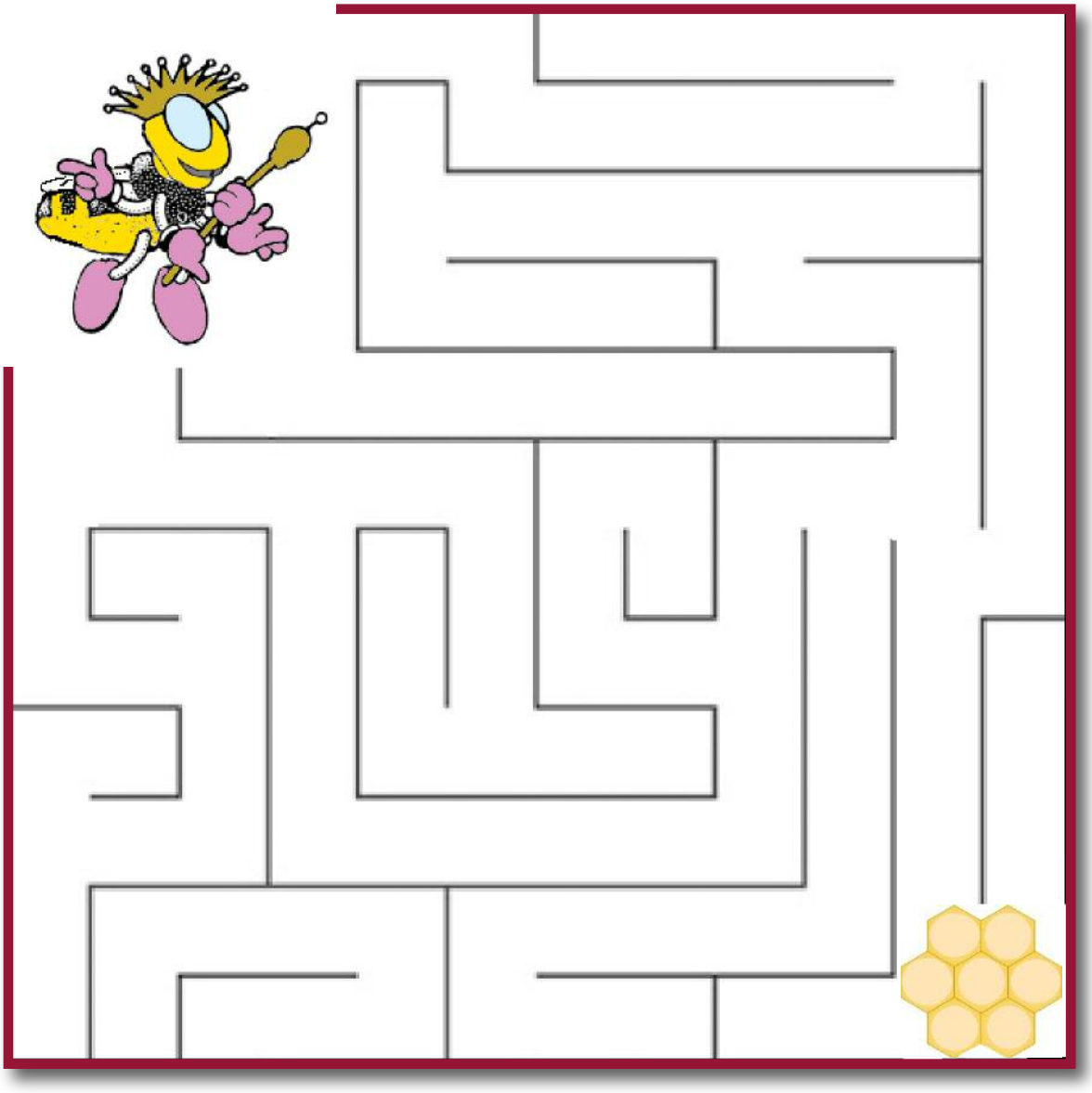
Insects use these for walking and holding. There are many places where they bend.

The small holes along the side of the insect used for breathing

Name _____

Mystery Bug → Bee Maze 1

→ Help the queen bee back to her comb.
(Can you find two ways of getting there?)

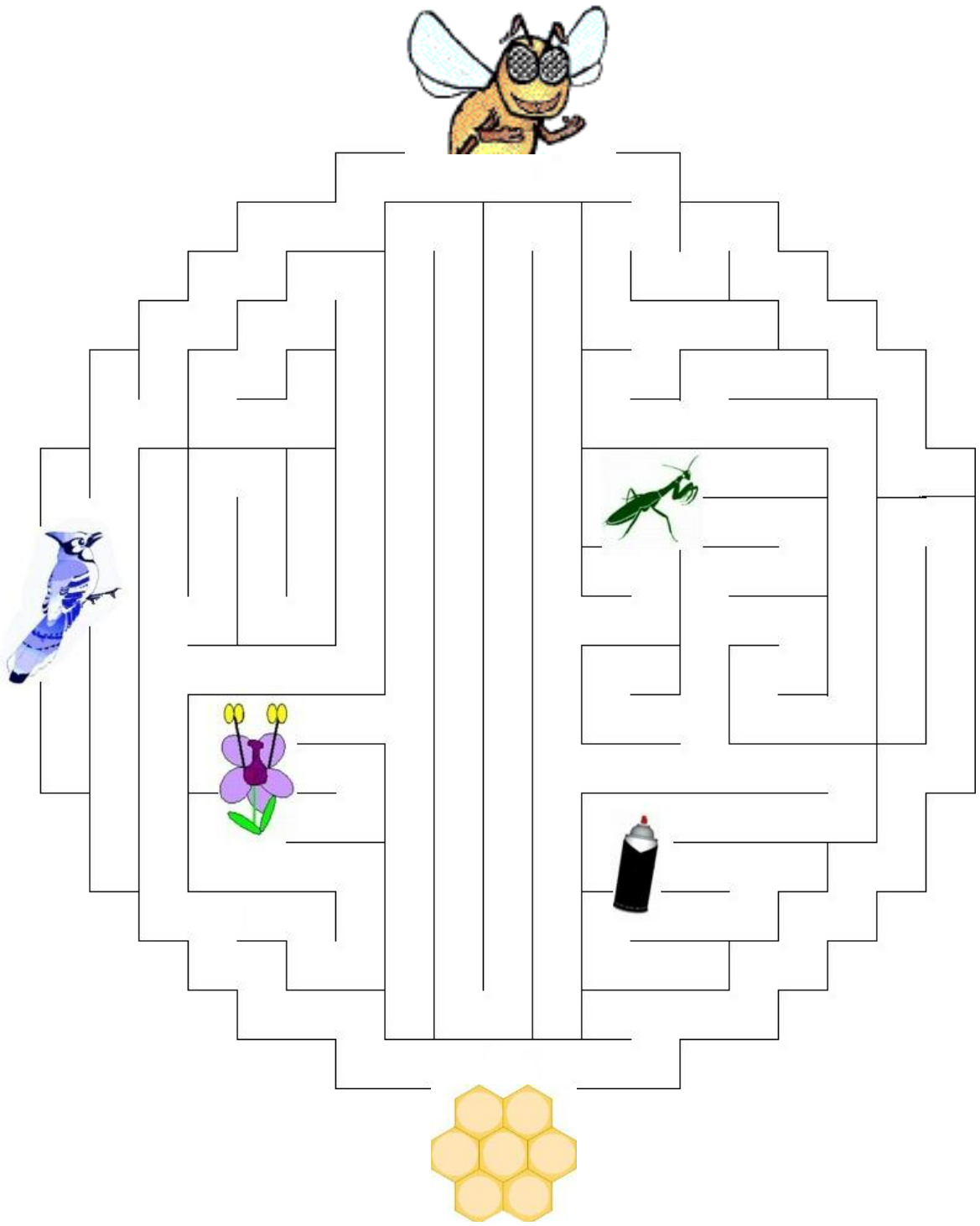


comb cells

Name _____

Mystery Bug → Bee Maze 2

→ First, help the worker bee collect pollen from the flower and then go on to the honeycomb. Watch out for danger!

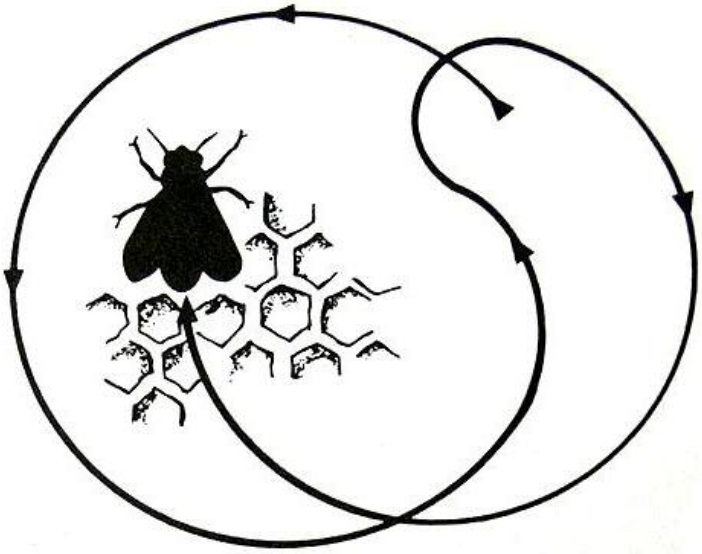


Name _____

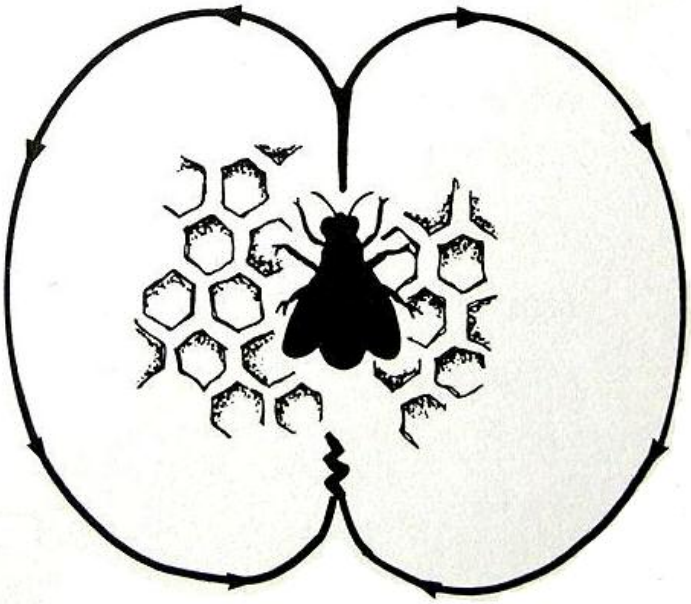
LESSON 2

Let's Look at Insects → Honey Bee Dances

→ **Round dance:** Move in a complete circle for two cycles and then change directions for two cycles.



→ **Waggle dance (Figure-8):** Take three steps on a straight line, turn left and loop around to the starting point. Make the three steps on the straight line again, but this time turn right and loop back to the start. Repeat as necessary.



Name _____

LESSON 2

Let's Look at Insects → Worksheet

→ Answer these questions by studying the insects or the posters.

1. The butterfly has _____ wings that are covered with scales.
   (number)

2. The butterfly has _____ antennae.
   (number)

3. The fly has only _____ wings.
   (number)

4. The type of eyes flies have are called _____ eyes.
   (type adjective)

5. The cricket has _____ jointed legs.
   (number)

6. The grasshopper uses its hind legs to _____.
   (verb)

7. The ground beetle has _____ body divisions.
   (number)

8. The body divisions of the earwig are called _____,
   (noun)
   _____, and _____.
   (noun) *(noun)*

9. The legs and wings are always attached to the _____.
   (body division noun)

10. The luna moth uses its antennae to _____.
    (verb)

Name _____

Let's Look at Insects → Activity Sheet A

→ Find and circle these insect parts in the puzzle below:

SPIRACLE	WING	JOINTED LEGS
HEAD	ABDOMEN	ANTENNA
COMPOUND EYE	MANDIBLE	THORAX

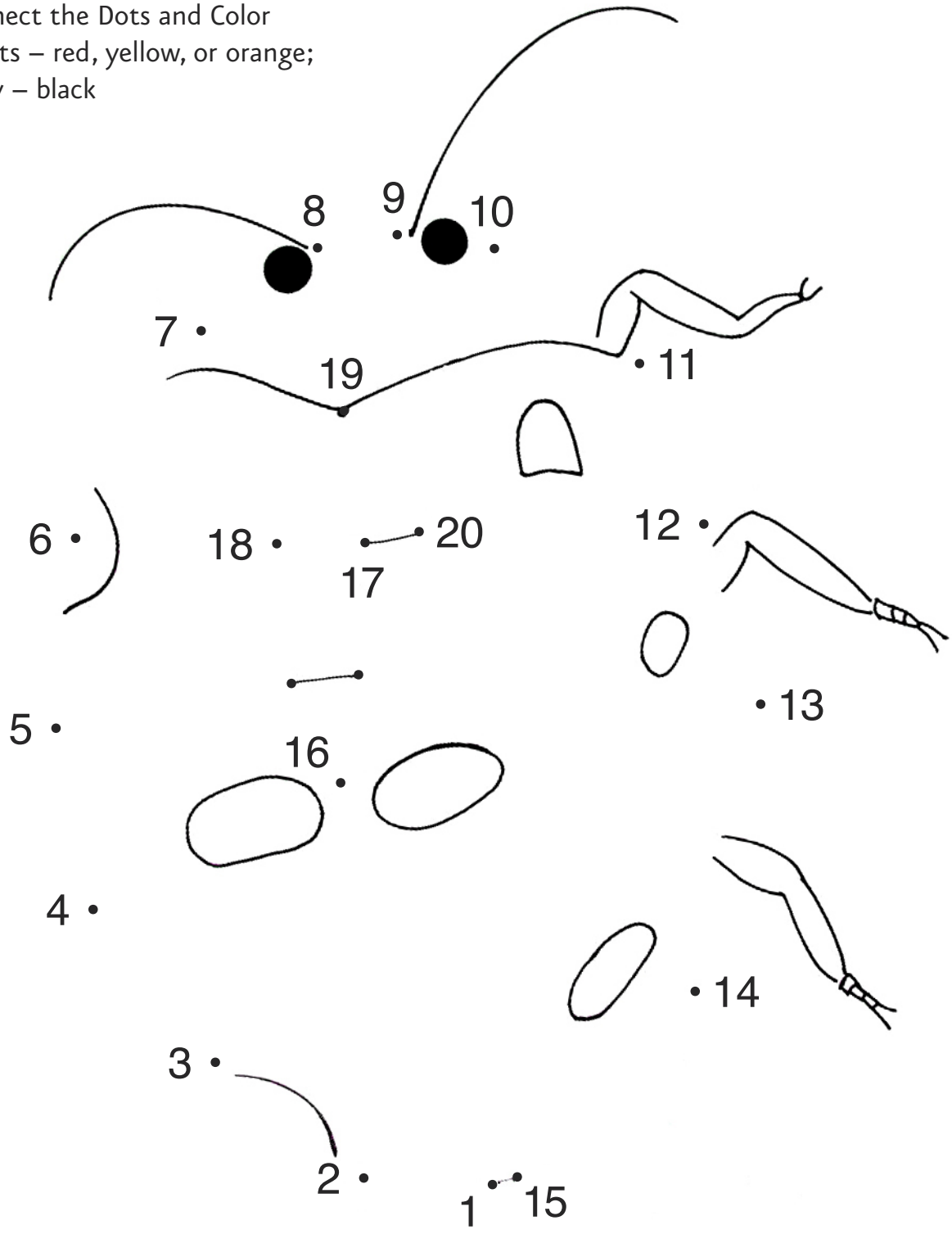
C	O	M	P	O	U	N	D	E	Y	E
Q	S	A	R	M	I	J	K	D	Y	X
S	P	N	L	W	E	T	B	V	A	P
L	I	D	Z	T	U	U	G	B	N	A
W	R	I	O	H	E	A	D	V	T	H
I	A	B	D	O	M	E	N	T	E	R
N	C	L	U	R	B	P	I	E	N	I
G	L	E	X	A	K	J	Q	C	N	P
X	E	Y	O	X	N	B	V	A	A	U
J	O	I	N	T	E	D	L	E	G	S

Name _____

LESSON 2

Let's Look at Insects → Activity Sheet B

→ Connect the Dots and Color
(Spots – red, yellow, or orange;
Body – black

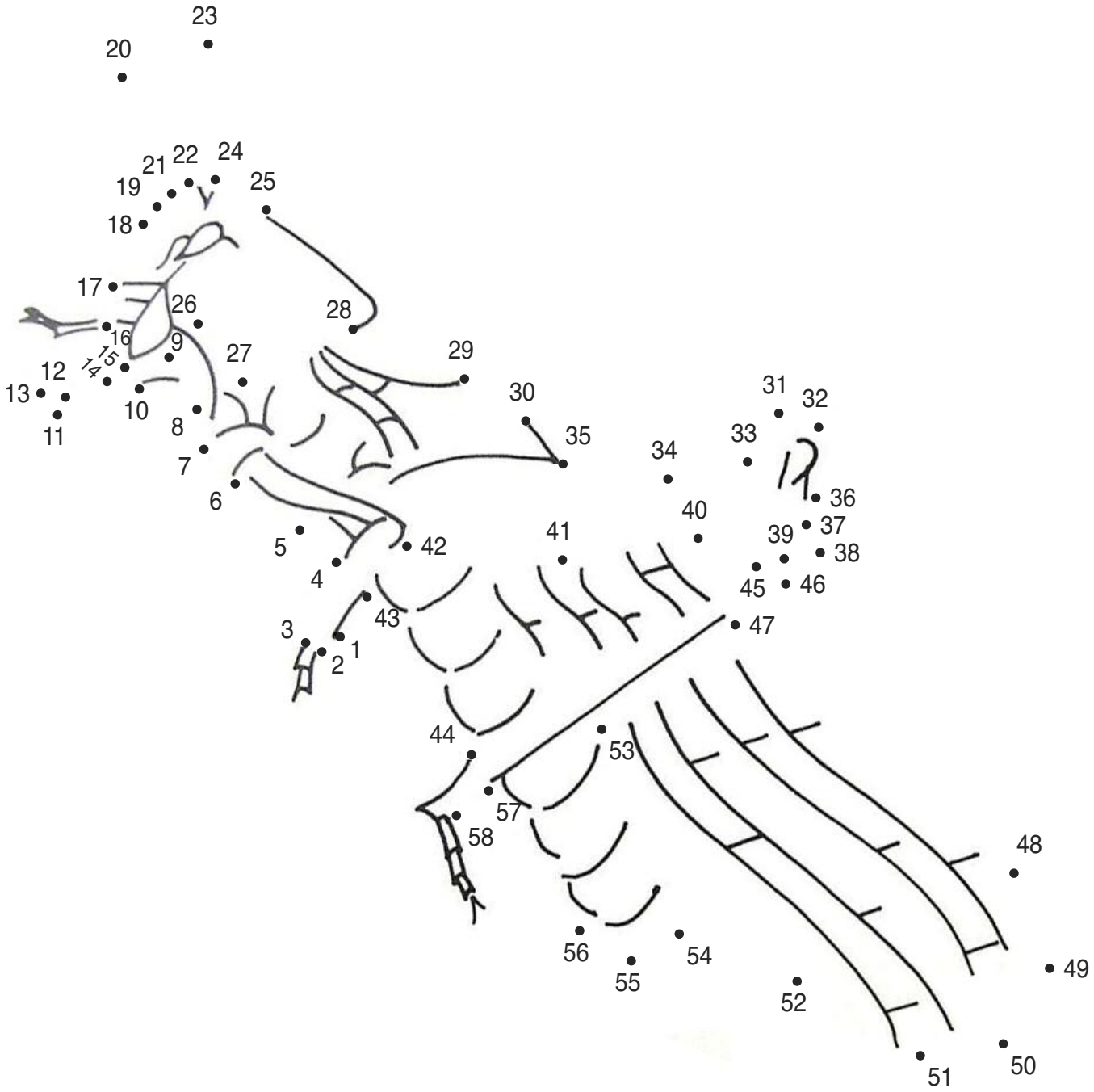


Name _____

LESSON 2

Let's Look at Insects → Activity Sheet C

→ Connect the Dots and Color. Use green, brown, black, yellow, etc.
Draw in some food for this insect. How many body parts do you see?

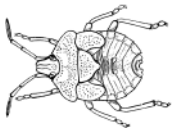


Name _____

LESSON 3

How Do They Grow? → Vocabulary Matching

→ Connect the words in the left column with their meaning or photo in the right column.

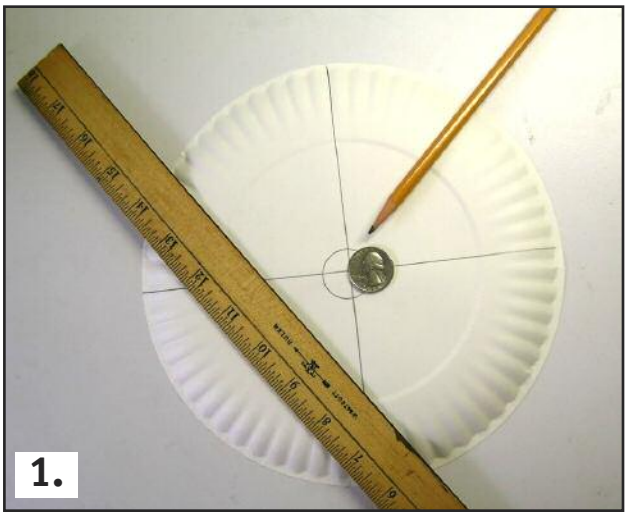
Exoskeleton	The tiny first stage in an insect life cycle
Cicada	The hard outside shell of an insect that gives it shape
Egg	The THREE stage life cycle of some insects
Nymph	When an insect sheds its skin to change to the next stage or size
Molting	
Simple metamorphosis	The FOUR stage life cycle of some insects
Complete metamorphosis	
Pupa	The fuzzy silk protection around an insect pupa
Larva	
Cocoon	

Name _____

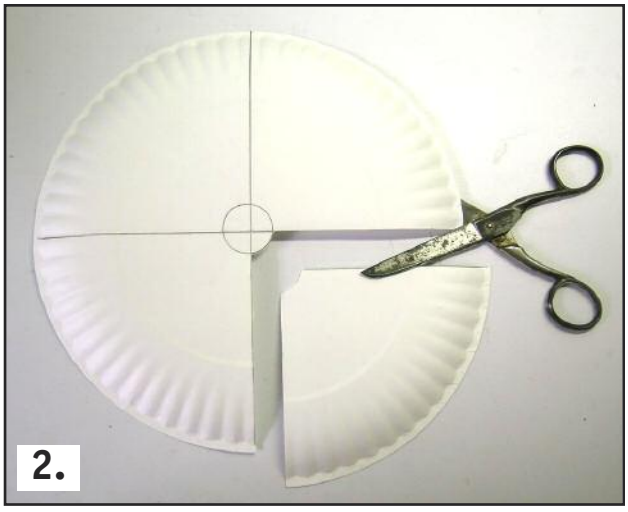
LESSON 3

How Do They Grow? → Life Cycle Wheel

1. Using a pencil and ruler, mark a proper "X" through the center of a paper plate giving four equal quadrants. (Fig. 1)
2. Trace a quarter to make a circle around the exact center. (Fig. 1)



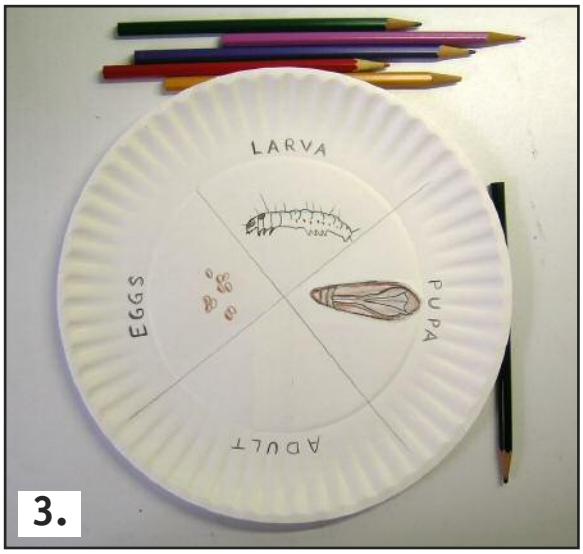
3. Cut out one of the quadrants and set the first plate aside for the moment. (Fig. 2)



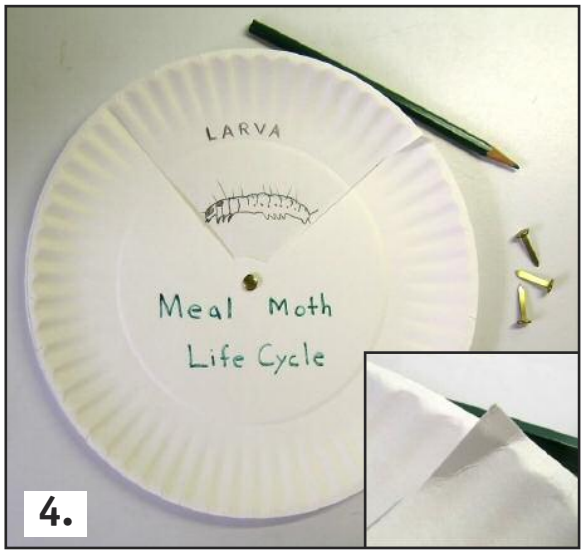
Name _____

How Do They Grow? → Life Cycle Wheel

4. On the second plate, make four more quadrants through the center with the pencil and ruler. (Fig. 3)
5. Using the Meal Moth diagram, (page 38) or any butterfly life cycle you like, draw and color each life stage inside one of the quadrants. Have each life stage face the center and make sure they are done in order. (Fig. 3)



3.



4.

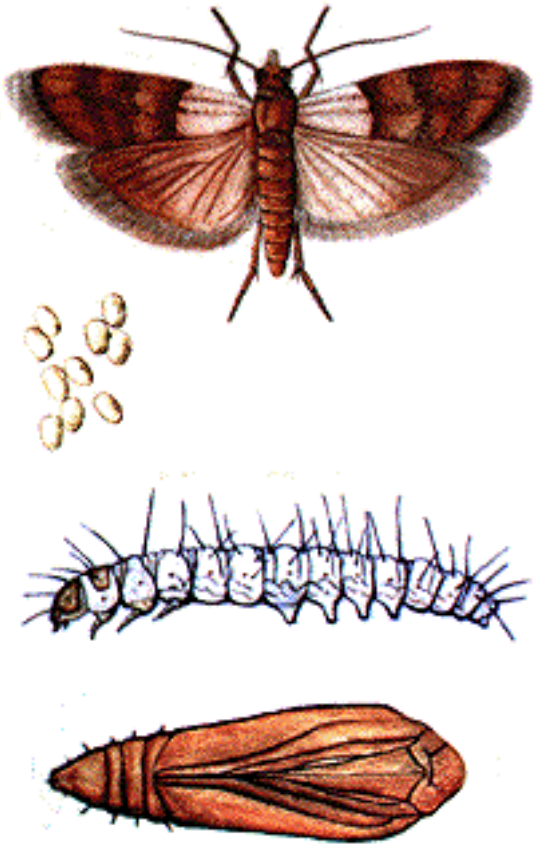
6. When all the drawings are complete, place the first plate (with the cut out quadrant) over the one with the insect drawings. Punch a hole in the center and insert the brad. (Fig. 4)
7. Label the outside of the wheel and decorate, if desired. Have them add their names somewhere.
8. If you like, you can fold over the tip of one quarter to help spin the wheel. (Fig. 4 inset)
9. Participants may take their life cycle wheels home to show family and friends.
10. Be sure to have participants help you clean up.

Name _____

LESSON 3

How Do They Grow? → Meal Moth

→ Meal Moth Life Stages
(Department of Entomology, University of Illinois Urbana-Champaign)



Name _____

How Do They Grow? → Magnet Board 1

→ Instructions for preparing the "How Do They Grow?" magnet boards are included here. Each county will probably want to prepare boards to have on hand for program use. The needed materials may be made by a volunteer leader before the "How Do They Grow?" lesson is conducted. The materials can be made as a club meeting activity, or the county extension 4-H agent could ask an older participant to make them for a special project.

(Instead of a magnet board, substitute a cork board, Velcro, or even tape. Use whatever surface is most convenient for you and adapt your materials.)

MATERIALS YOU'LL NEED →

- Magnetic white board or dry erase board. Magnets.
- Copies of drawings and labels cut out from the next page. For a more sturdy product, labels and pictures can be cut out and glued to heavy paper or light cardboard. They could also be laminated.
- Color markers
- "Golden Guide Insects" by Herbert S. Zim and Clarence Cottam, 1987, 1956, (your public library should have a copy) is optional but very helpful.

PROCEDURE →

1. Color and cut out the line drawings according to the directions.
2. Use two colors for the labels: one for complete metamorphosis and one for simple metamorphosis. Cut the labels as rectangles.
3. For a more sturdy product, labels and pictures can be cut out and glued to heavy paper or light cardboard. They could also be laminated.

The following pictures and labels will be needed:

Name _____

How Do They Grow? → Magnet Board 2

EGG

EGG

LARVA

ADULT

NYMPH

ADULT

PUPA

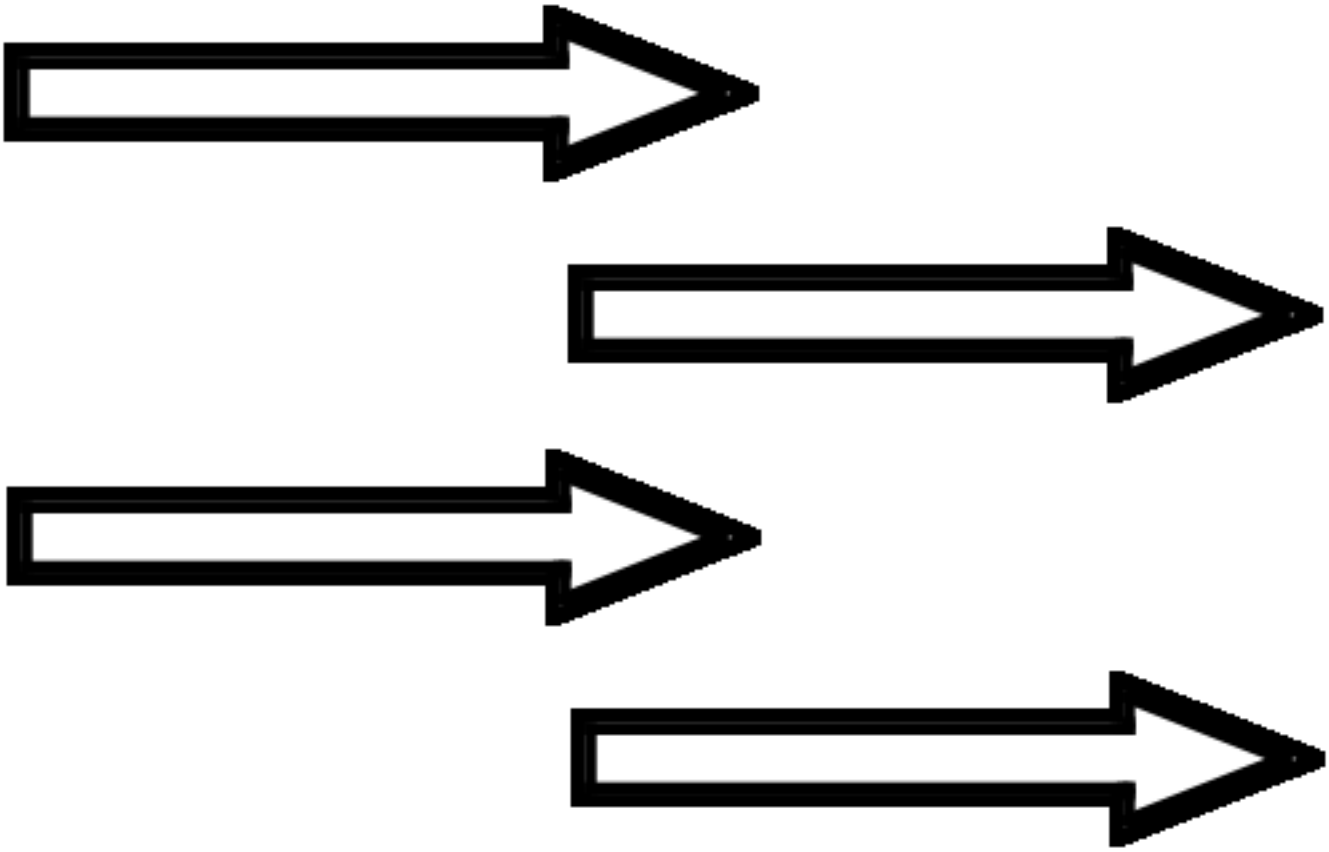
CICADA

BUTTERFLY

Name _____

Simple Metamorphosis

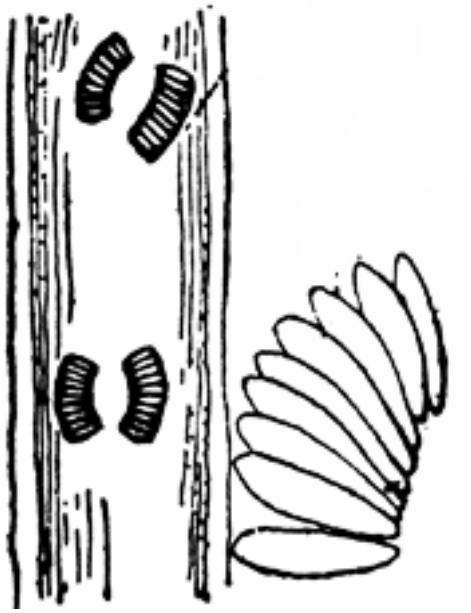
Complete Metamorphosis



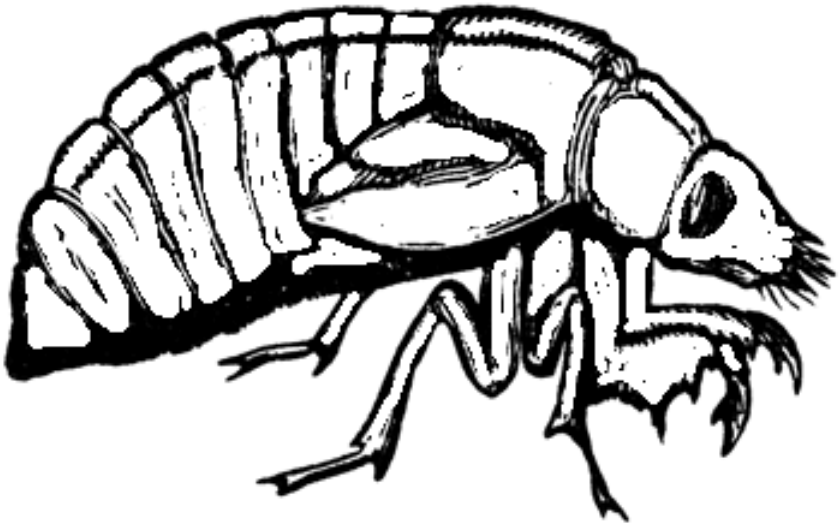
Name _____

How Do They Grow? → Magnet Board 4

Simple Metamorphosis
Cicada Eggs (Color eggs yellow and stem tan.)



Simple Metamorphosis
Cicada Nymph (Color tan/brown)



(ClipArt from Educational Technology Clearinghouse)

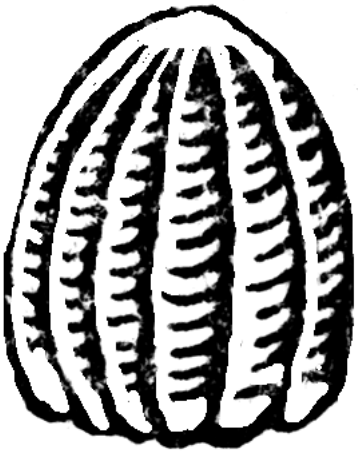
Name _____

LESSON 3

How Do They Grow? → Magnet Board 5

→ **Cicada Adult** (Color wings and body green, head brown)

→ **Complete Metamorphosis** Monarch Egg (Color yellow)



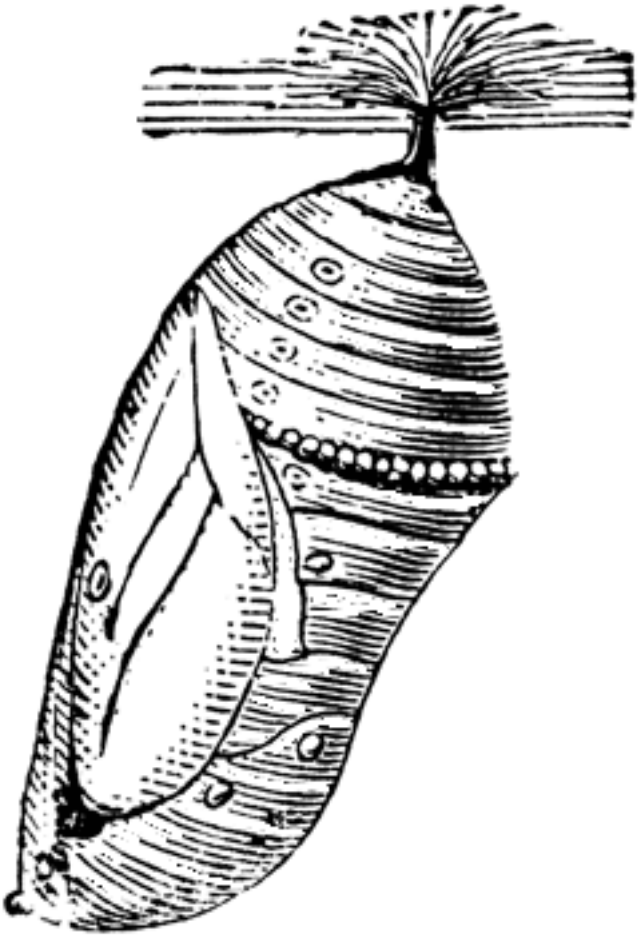
→ **Monarch larva** (Color the grey stripes yellow/orange)

(ClipArt from Educational Technology Clearinghouse)

Name _____

How Do They Grow? → Magnet Board 6

→ **Monarch pupa** (Color light blue-green)



(ClipArt from Educational Technology Clearinghouse)

Name _____

How Do They Grow? → Magnet Board 7

→ **Monarch Adult** (Color wings rusty orange)

(ClipArt from Educational Technology Clearinghouse)

Name _____

It's a Bug's Life → Worksheet

→ Observe your insects 5 to 10 minutes. Fill in the blank below.

1. Type of insects:

_____

2. Did the insects eat while you watched them?

_____

3. If so, did they use their legs to hold the food?

_____

4. Did they move their heads while they ate?

_____

5. What part of the plant did the plant eaters eat?

_____

6. How much of the plant did they eat?

_____

7. Did the insects move around the chamber while you watched?

_____

8. Did they run, jump, fly, crawl? Where did they go? Do you know why?

_____

9. What else did you see your insects doing?

_____

Name _____

LESSON 6

Bug Parts Bingo → Words

Abdomen – the last of the three body regions or the "tail" section.

Antennae – the pair made of the left antenna and the right antenna (pl. is not antennas) usually used for smelling, tasting, and touching.

Bird – important predators of grasshopper nymphs and adults.

Blister beetle – is a predator of grasshopper eggs.

Claw – structure on the tip of the legs that helps the grasshopper cling to plants.

Compound eye – one of two large eyes responsible for vision and located on the head.

Ear drum – hearing organ on a grasshopper abdomen used to detect sound.

Eggs – usually laid in clusters underground.

Forewing – one of the two wings in the pair that is closest to the head.

Front legs – the legs located on the first third of the thorax, closest to the head.

Grass – one of the important foods for grasshoppers that also provides shelter.

Hindwing – one of the two wings in the pair that is farthest from the head.

Jaws – large parts of the mouth that are used for cutting and chewing grass.

Leg Femur – the part of the grasshopper hind leg that is large and important for hopping.

Leg joint – a point at which two segments of a leg join and move like an elbow.

Middle legs – the legs located in the middle third of the thorax.

Nymph – the second stage in grasshopper metamorphosis. This young stage is smaller and lacks wings.

Ocelli – three small, simple eyes located on the front of the head that are used to detect brightness.

Ovipositor – structure at the tail end of the female grasshopper abdomen that is used for laying eggs.

Pronotum – the large armored portion of the exoskeleton covering the front and top of the thorax.

Spines – thorn-like projections on the legs.

Spiracles – the line of small openings along the side of the insect (except the head) used to take in air for breathing.

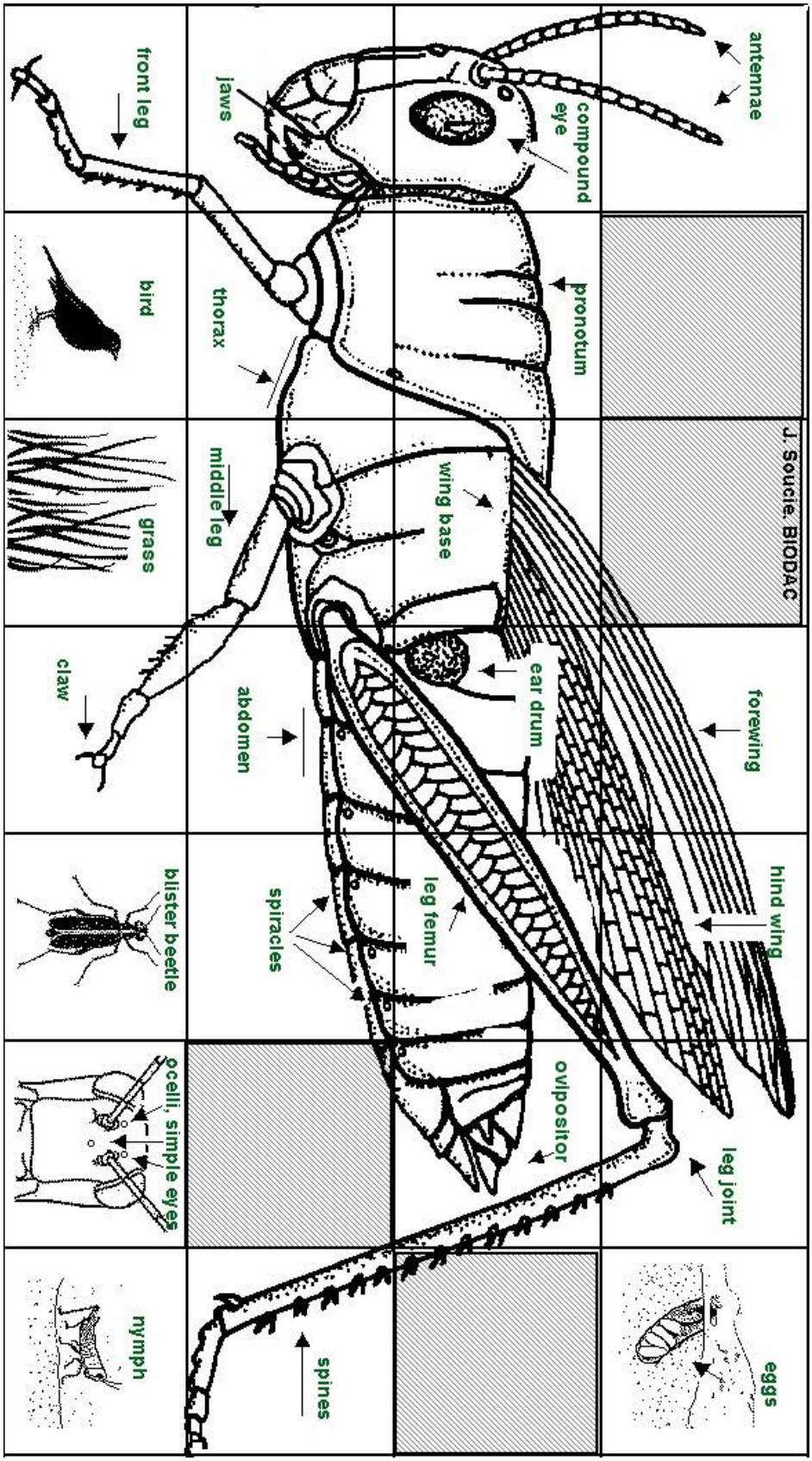
Thorax – the middle section of an insect, located between the head and abdomen. It often has three main sections, each with a pair of legs, and it also bears the wings.

Wing base – the point at which the wing attaches to the thorax. Is important for the wings to be able to move and change position.

Name _____

LESSON 6

Bug Parts Bingo → Parts of a Grasshopper



Name _____

Bug Parts Bingo → Blank Card

		 FREE		