Fermi National Accelerator Laboratory

Insects at Work in Our World

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Insects at Work in Our World

An elementary program for apprentice entomologists

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On Beyond Bugs

“All day and all night,
on the ground, in the air,
insects are moving around everywhere.
It’s important for us
to keep learning about them.
The world that we know
Couldn’t go on without them.”

Tish Rabe

Introduction

Insects are everywhere . . . from the highest mountains to the shores of the deepest oceans; from the hottest deserts to the coldest regions of the Earth. They are in the soil beneath your feet, the air above your head, the water you splash in, and even on you. Insects have inhabited the earth for hundreds of millions of years. Currently, there are more than one million different identified species of insects in the world—making up more than half of all living things on this planet! Scientists believe this may only be a fraction of what exists and that there may be more than four million insects that have yet to be discovered. Perhaps there is a student in your classroom who will discover a species of insects not yet known to man!

Without insects to pollinate plants, serve as food for other living things, decompose organic materials, till the soil and prevent overpopulation of arthropods, the world we live in today would not be the same, or might not even exist. "So important are insects and other land dwelling arthropods that if all were to disappear, humanity probably could not last for more than a few months" states Edward O. Wilson of Harvard University. These facts give good reason as to why this generation needs to be taught the connection that exists between humans, insects and the natural environment.

Insects belong to a group of animals called arthropods. There are five major classes of arthropods, and insects belong to the largest group. Insects are characterized by having three body segments—the head, the thorax, and the abdomen. They have six legs and usually two pairs of wings attached to the thorax. Insects display antennae and most have compound and/or simple eyes. Scientists classify insects into groups. Species that have scientific names can be recognized anywhere in the world regardless of what language is spoken. Currently there are 32 different orders of insects. Eight of the more common orders are *Coleoptera* (which means sheath-winged), *Diptera* (two-winged), *Hemiptera* (half-winged), *Homoptera* (same-winged), *Hymenoptera* (membranous-winged), *Lepidoptera* (scaly-winged), *Odonata* (strong-jawed) and *Orthoptera* (straight-winged).

All living things experience a life cycle. A life cycle is a repeating process of birth, growth, reproduction and death that occurs among every living species. Most animals including fish, mammals, reptiles, birds and silverfish have very simple life cycles. *Simple life cycles* consist of three stages—birth, young and adult. Less than 1% of all insects have simple life cycles. Some animals have a slightly more complicated life cycle called an *incomplete life cycle*, characterized by a three-stage cycle—egg, nymph (young stage when most of the feeding is done) and adult (final breeding stage). Approximately 10% of insects fall into this group, and include insects such as dragonflies, damselflies, milkweed bugs, water bugs, cicadas, aphids, praying mantises, grasshoppers and katydids. Most insects (approximately 90%) undergo a *complete metamorphosis* passing through amazing changes to become an adult. They have four stages in their life cycle—egg, larva (young stage when most of the feeding is done), pupa (inactive with no feeding between larva and adult) and adult (final breeding stage).

There are five main roles insects play: 1) decomposers, 2) pollinators, 3) soil tillers, 4) producers and 5) population controllers. Insects play a very important role in the health of our environment. As decomposers, insects rid the world of decaying organic matter and replace it with nutrients that feed the soil and are used by plants. Pollinators such as bees, beetles, flies, wasps, butterflies and moths, become covered in pollen. As they move from plant to plant, feeding, they pollinate or fertilize plants. Soil tillers turn over the soil, allowing air and water into the ground, helping make it better suited for growing plants. Insects produce materials that are useful to people and other living things. Honeybees give us honey to eat and beeswax that can be made into candles, the larva of the silkworm moth produces silk that can be made into cloth, and fly maggots have been used in medicines to help clean and treat wounds. Insects known as population controllers hunt, capture and eat other insects. In this way, they help reduce the number of insects that might destroy our gardens and crops. As you can see, insects are busy at work in our world.

Hundreds of species of wildlife, such as mammals, birds and insects are now found at Fermilab. Prairie restoration began in the Main Ring at Fermilab in 1975. Dr. Robert Betz, former professor of biology at Northeastern Illinois University, Raymond Schulenberg, former curator of plant collections at Morton Arboretum, and a few dedicated Fermilab employees piloted the project. Thus began a project that eventually led to over 1,100 acres of prairie being restored on the Fermilab site. Many of the insects present are vital to the success of the prairie plant community as they pollinate, till the soil, and are food which support the population of larger animals. Conversely, the diverse prairie plant population should encourage the presence of many different kinds of insects.

In a natural wooded area, decomposing logs and leaf litter are in the process of returning food and nutrients to the soil. The insects and their relatives aid fungi and other organisms in this decomposition. Areas under the bark and logs provide homes for these organisms. Decomposers visible to the naked eye may be observed at the on-site Fermilab visit.

Some species of insects live in and around the wetland areas. Examining invertebrates living in the water can help determine the quality of the wetland. A wide variety of diversity of invertebrates generally indicates better water quality.

It is never too early to teach the ideas of conservation and thoughtful consideration of our actions on the environment. Unless people understand the interconnections between all living things, they may initiate action that could have devastating consequences. If people develop an appreciation for insect populations and an understanding of the benefits they provide, they will be more likely to consider the effects of using pesticides or of introducing non-native species into the environment. Children are exposed to negative attitudes toward insects very early in life; after all, bees and wasps sting, “bugs” bite, and ants, flies and other “bugs” get into our food. Only 3% of known insects are actually pests. The true number is probably much less than 1% since insect pests are much more visible than their helpful counterparts.

There are many delights awaiting the curious child, quite possibly in their own backyard. At some point, most children love collecting caterpillars, chasing butterflies, capturing lightning bugs, digging for ants or touching pill bugs to see them roll into a ball. Taking advantage of this natural curiosity, it's up to us, as adults, to teach children about the natural wonders all around us and how our actions can greatly affect the overall health of even our own backyard environment. Children need to be taught to observe without disturbing wildlife and should be encouraged to always put living things back where they were found.

Overview

At Fermilab, an exciting example of our past and our future, we search for elusive particles that make up our universe. These particles have been around since the beginning of time. Future discoveries at Fermilab will lead to a better understanding of how the universe is made and how it works.

Well known as a national physics laboratory, Fermilab was also designated as a National Environmental Research Park in 1989. Fermilab's restored prairies, forests, ponds and grasslands are home to many insects. Insects have been around for millions of years, and like the particles, many are elusive.

The goal of *Insects at Work in Our World* is to provide young learners with the opportunity to observe and study insects to be apprentice entomologists. The engaging hands-on, interactive focus of this instructional unit is these elusive "critters" and the need to protect them and their environment.

Research Component
Students prepare for field studies at Fermilab by gathering background information and practicing skills of observing, questioning, sorting, keeping records and sharing information. They keep their work in an insect journal. They conduct field studies collecting, sorting and comparing insects from several habitats and discuss their findings.

When students learn interesting facts about insects and become more familiar with their habits, the "fear factor" is often removed from working with live specimens. By collecting and observing live specimens, students are often motivated to do further research on their own to find out more about the insects they have observed.

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.
- Throughout their life cycles, the structures of insects change and may look very different from one stage to another.
- The five main jobs of insects are decomposers, pollinators, soil tillers, producers and pest controllers.

Developing Scientific Thinking Processes and Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.

2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.

3. Communicating:
   a. Scientists work in cooperative groups, discussing observations and ideas.

b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
c. Scientists share descriptions of their work with others.

4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   c. Scientists organize objects according to their similarities and differences.

<u>Class Time</u>
Student interest is best generated through scientific inquiry, “doing science.” We divide class time into three sections.

Engaging the Students
Generate student interest by confronting their understanding with an interesting artifact or question. For example, students could examine insect models, live insects, preserved insect collections or pictures.

Facilitate a discussion by asking students “what they know and what they would like to find out.” Set up a way to post and track student input. As a rule:

- Post items throughout the unit.
- Accept all comments and questions. Consolidate similar items.
- Return to questions that students can answer through their research and post answers.
- Replace or remove items that students learn are no longer relevant or appropriate.

Investigating
Provide students (ideally in pairs) with specimens, tools and time to investigate. Refer to the postings and remind students of the purpose of their investigations. Give each student an opportunity to use all the tools. Have each student record the observations made by all members of the group in his or her journal. Their journals should include written observations and detailed drawings where appropriate. They could also attach pictures or other materials they acquire. A dictionary in the back of the journal allows students to keep a list of new words and their meanings.

Sharing and Summarizing
Have research groups share the findings. Facilitate discussion among the groups to help students determine which observations were accurate. Post the accurate findings. Compare these findings to the postings done prior to their investigations. Facilitate a discussion to determine whether or not the earlier postings are valid. Eliminate any information from the postings that the students have agreed are incorrect. Have students add the corrected information to their journals. Revisit the student’s questions to determine if any of them were answered by their investigations. If so add this information to their journals. An appropriate book related to the lesson may be read to the students. As students investigate and increase their knowledge about insects, they will be acting as apprentice entomologists, scientists who study insects. Putting students in this role will increase their desire to practice scientific inquiry by asking questions, investigating to answer their questions. It will entice them to want to share their findings with their classmates and to want to find out more.

Like all scientists, entomologists must keep detailed records of their research and findings. During class, students will record questions, drawings and notes in their science journals, which may be reviewed as part of unit assessment.

Teaching Tips

Cooperative Learning Strategies

Scientists often work collaboratively to share knowledge and solve complex problems. Often the task of collecting the specimens is difficult for small children, and they are better able to accomplish this task with the help of others. Working in small groups to collect and observe specimens allows students the opportunity to interact with other students to accomplish their goal of gaining information from live specimens. Shared observations add to the experience.

Collecting Insects

Fermilab's prairies, ponds, forests and grasslands are excellent environments in which to study insects and their relatives. The diversity of plants in these communities provides habitats for many species of insects. An on-site visit to Fermilab gives students the opportunity to compare insects from these different habitats. The docent-led field trip enhances the learning that has taken place in the classroom.

If an on-site visit is not possible, habitats in the schoolyard or nearby should be used to enhance classroom learning. As the students work in these habitats, it is important to emphasize that the surroundings should be disturbed as little as possible and that all specimens be returned to where they were found.

Recording Data

Scientists keep a journal of their work. Each student should be provided with a journal for recording data. By referring back to the data in their individual journal, the student will be able to add to the discussion when comparing and organizing class data. A sample journal cover and page is provided at the end of this section. The dictionary pages may be added to the back of the journal to allow students to keep a record of new words they learned while doing science.

Live Insects in the Classroom

Live insects and their habitats may be ordered from a science supply house (see Resources). Live insects used in the Metamorphosis Live Exploration should be ordered before beginning the unit of study. This allows students to make and record observations of the live specimens while performing other explorations and activities in the unit.

Insects at Work in Our World

Entomologist___________________________

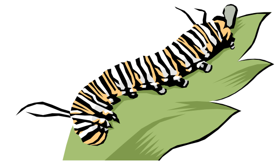
A "Bee" C Insect Dictionary

Entomologist_________________________________ Date_____________________

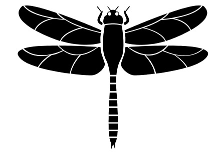
Aa is for ant.

Bb is for beetle.

Cc is for caterpillar.



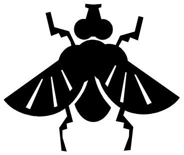
Dd is for dragonfly.



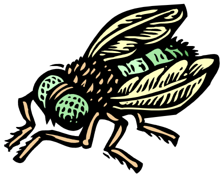
Ee is for entomologist.

Ff is for firefly.

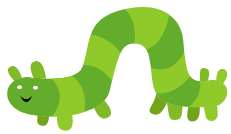
Gg is for gnat.



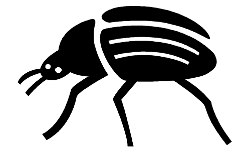
Hh is for housefly.



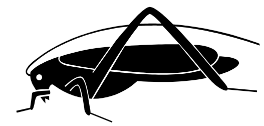
Ii is for inchworm.



Jj is for Japanese beetle.

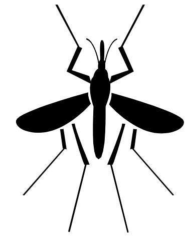


Kk is for katydid.

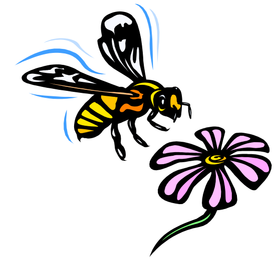


Ll is for ladybug.

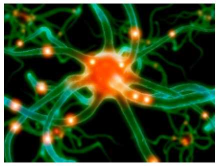
Mm is for mosquito.



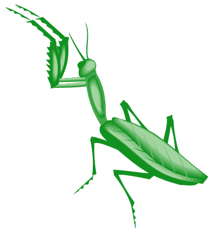
Nn is for nectar.



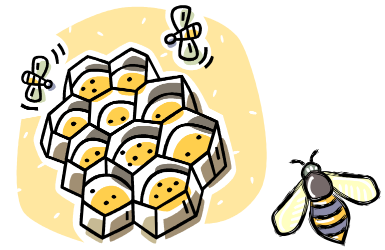
Oo is for organisms.



Pp is for praying mantis.



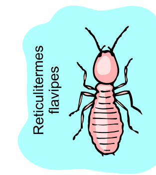
Qq is for queen bee.



Rr is for researching insects.

Ss is for swallowtail butterfly.

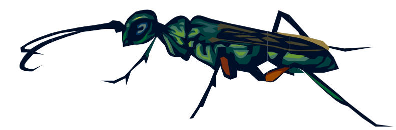
Tt is for termite.



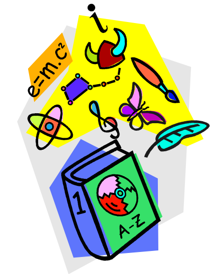
Uu is for understanding insects.

Vv is for velvet ant.

Ww is for wasp.



Xx Yy Zz insect dictionary



Science Exploration 1-1

Insects and Entomologists

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists share descriptions of their work with others.

Learner Outcomes

Students will be able to:

- Describe some of the characteristics of insects by studying models.
- Describe some roles of an entomologist.
- Record observations in journals.

Materials

- Insect collection
- Pictures of insects
- Models of insects
- Magnifying lenses
- Entomologist model (Outline of person on poster board or plywood)
- Post-its
- Book, *On Beyond Bugs! All About Insects,* by Tish Rabe
- Science journals (to be made by teacher ahead of time)
- Insect Parts worksheet
- Book, *Insects Are My Life*, by Megan McDonald
- Activity 1: Create an Insect
- Activity 2: Using My Senses
- Activity 3: Hop to It!
- Activity 4: Fascinating Facts
- Activity 5: Insect Riddles

Background

When children are asked to name an "animal," rarely do they think of insects. They may mention dogs, cats, rabbits, usually something "cute and furry." Yet, humans, fish, and insects are all animals. Although animals may look very different from one another, they share common characteristics and needs. For example, all animals need food, water, shelter and space.

Other characteristics and needs are specific to a certain group of animals. Insects belong to the group of animals classified as invertebrates because they lack a backbone. They belong to a smaller group called arthropods that are characterized by having an exoskeleton (hard external skeleton), a segmented body, and at least three pairs of jointed legs.

Entomologists, scientists who study insects, further characterize insects as having three body parts: a head, which has eyes, mouthparts, and antennae; a thorax, to which the legs and wings are attached; and an abdomen, which usually holds most of the digestive system and the reproductive organs.

The group *Insects* is one of the most diverse groups of animals, having over one million species that come in many colors, patterns and shapes. It is their characteristics, rather than their general appearance, that allow entomologists to group insects together. It is also these characteristics that allow insects to survive in many different habitats and to stay busy at work in our world.

Class Time

Exploration Part I

Engaging the Students

- Ask each student to name an animal or what animal they would like to be. Share your insect collection and/or photographs of insects and ask the students if these insects are animals?
- Ask each student if they could be an insect, what insect would they like to be?
- Find out what students know and would like to find out about insects.
- Post results.
- Hand out model insects and journals to students.

Investigations

Students will:

- Work in cooperative groups.
- Examine insect models and record what they observe in their journals.
- Draw their insect and label parts they recognize. (Of course, writing a short description or taking a few notes is also a good idea.)

Sharing and Summarizing

- Facilitate discussion on insect characteristics, after groups share what they have observed.
- Post their findings
- Read book, *On Beyond Bugs! All About Insects.*
- Activity 1: Create an Insect

Exploration Part II

Engaging the Students

- Let the students know that when they study insects, they are apprentice entomologists.
- “Introduce” the students to an entomologist (outline or model of a person) as a scientist that studies insects.
- Set the stage to build a description of the jobs an entomologist does and the tools (s)he uses.
- Hand out a magnifying lens to each student.

Investigations

Students will:

- Use magnifying lenses to examine the insect models.

- Record any new observations in their journals.

Sharing and Summarizing

- Facilitate a discussion on how the students investigate insects: studying insect models, drawing/taking notes about specimens, sharing what they observed.
- Start a class description on Post-its® or by writing directly on the model of the entomologist. (As they practice new skills, students will be able to add new ideas to the model.)
- Check students' knowledge by having them complete the *Insect Parts* worksheet and add it to their journal.
- Record any new vocabulary words in the back of their journals.
- Activity 2: Using My Senses
- Activity 3: Hop to It!
- Read book, *Insects Are My Life.*
- Ask students how Amanda knew all the interesting facts in the story.
- Facilitate a discussion of the facts in the story.
- Activity 4: Fascinating Facts
- Activity 5: Insect Riddles

(To be used with Science Exploration 1-1)
Kinesthetic – Activity 1

Create an Insect

Materials

- White tube sock for each child
- Rubber band for each student plus extras
- Three 1/2 pipe cleaners (per child)
- Stuffing for sock (could include fluff, newspaper, etc.)
- 1/3 pipe cleaner (per child)
- Paper or foam wings, if necessary
- Wiggly eyes, beads or marker for eyes
- Glue and markers
- Insect Body Parts sheet
- Song, *Insect Bodies,* by Victoria Smith
- Song, *The Insect Song,* by M. Hubbard

Activity

1. Introduce the completed sock insect. Tell the class that they are going to make their very own insect today. The insect must have three body parts and some may have wings. Students may decide what insect they will make but must get the basic insect body completed first. Sing the song *Insect Bodies* while reviewing parts of an insect.
2. Pass out socks and three 1/2 pipe cleaners for feet. Make sure there is enough stuffing at every table to fill the insect.
3. Have students stuff the socks with a small handful of stuffing. First make the head. Separate it from the rest of the sock with a 1/2 pipe cleaner, folded in half, and twisted around the neck to create the head. Bend the ends of the pipe cleaner to create feet.
4. Put more stuffing after the head to create the thorax. Separate the thorax from the abdomen by twisting two 1/2 pipe cleaners, folded in half, around the body. Bend the ends of the pipe cleaners to create feet.
5. Stuff the abdomen last. This will be the largest segment. When about three-fourths is stuffed, twist a rubber band around the end of the abdomen to close, and pull the end of the sock back over the end.
6. Take time to review with the class that the insect body has three parts—the head, thorax and abdomen.
7. Demonstrate how to attach antennae to the head by gently threading the 1/3 pipe cleaner through the head of the sock. Take a marker and draw on eyes or glue wiggly eyes on the head.
8. Have students point to the thorax. Review that the thorax contains the six legs and sometimes wings. At this point, have the students add wings (optional).
9. Have students point to the abdomen. Discuss that many body organs are within the abdomen.
10. Have students decorate their insect and share with their peers.
11. Review with the class the parts of the insect by singing *The Insect Song.*

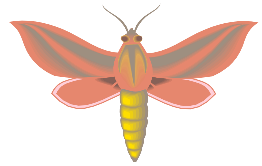
Entomologist ______________________

Insect Body Parts

I________I________I   I________I________I   I________________I________________I

head   thorax   abdomen

<u>Insect Project</u>



As you are aware, we are learning about insects! We now know for sure:

1. All insects are "bugs," but not all "bugs" are insects.
2. All insects have 3 body parts, 6 legs and 2 antennae.
3. Most insects have wings.

Today we created some rather large insects using socks! Our focus was on the 3 body parts, 6 legs and 2 antennae. Your child is now bringing the insect home to "add the details!" They have chosen an insect that they would like to create and need your help with adding color, wings, etc. They may use any materials they can find. Some things we talked about were: paint, markers, fun foam, cloth, clear plastic or whatever you have around the house. They may need your help in looking their insect up on the Internet so they can see exactly what it looks like. You can make this project as simple or as elaborate as you would like, but I would like for it to show the creativity of the **students** more than the creativity of the parents. ☺

The insect your child indicated they would like to create is:

____

The insects can be returned to school at any time but are due on

_______________________.
(Date)

Thank you in advance for your help!

__________________________ and the Entomologists of ______ .
(Teacher) (Class)

Insect Bodies!

By Victoria Smith

(Tune: If You're Happy and You Know It)

Every insect's body has three parts.
Yes, every insect's body has three parts.
Every insect has a head,
A thorax and abdomen.
Every insect's body has three parts.

Every insect's body has six legs.
Yes, every insect's body has six legs.
They have three legs on each side,
And they walk on them with pride.
Every insect's body has six legs.

The Insect Song

(Tune: London Bridge)

Every insect has 3 parts,
has 3 parts, has 3 parts.
Every insect has 3 parts.
I can name them all!

Head and thorax, abdomen,
abdomen, abdomen.
Head and thorax, abdomen.
An insect has 3 parts!

Every insect has 6 legs,
has 6 legs, has 6 legs.
Every insect has 6 legs.
Count them all to see!

Every insect has antennae,
has antennae, has antennae.
Every insect has antennae.
That is how they smell!

Insects usually have some wings,
have some wings, have some wings.
Insects usually have some wings,
That is how they fly!

Every insect has 3 parts,
has 6 legs, and antennae.
Every insect has these things.
Some even have wings!

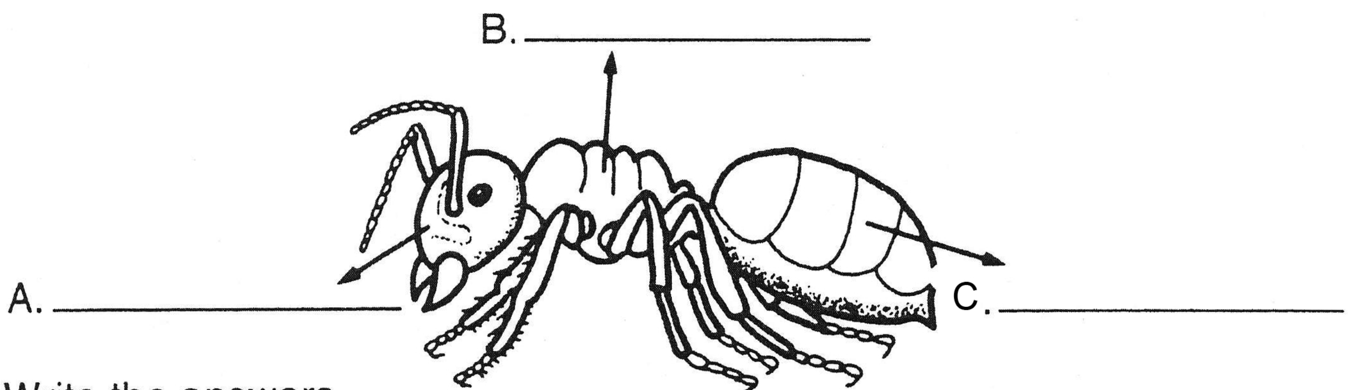
M. Hubbard

Entomologist ______________________________

Insect Parts

Insects come in many colors, shapes and sizes. Insects have six legs and three main body parts. They have a **head**, a middle part called the **thorax,** and a back part called the **abdomen**. They also have two feelers on their head called antennae. These body parts make insects different from animals like worms and spiders.

Label the three main body parts of the ant. Use the words in **dark print**.



Write the answers.

1. How many legs does an insect have?
____

2. What are an insect's feelers called?
____

3. How many main body parts does an insect have?
____

4. Name the main body parts of an insect.
____

Brainwork! Draw another insect and label its parts.

Answers: A) head B) thorax C) abdomen 1) six 2) antennae 3) three 4) head, thorax, abdomen

(To be used with Science Exploration 1-1)
Health – Activity 2

Using My Senses

Materials

- Book, *My Five Senses,* by Aliki
- When I… worksheet
- *Walking on Ears* read-aloud poem
- Book, *A Very Quiet Cricket,* by Eric Carle
- Cricket Senses worksheet
- Senses Chart
- Pencils

Activity

1. Read the book, *My Five Senses,* to the students. Discuss human senses.
2. Have students complete the worksheet When I______, I use _____(how many) of my senses.
3. Read the book, *A Very Quiet Cricket,* by Eric Carle and review Cricket Senses worksheet with students, appreciating the different senses in the cricket.
4. Assign each line of the poem, *Walking on Ears,* to a student to read aloud.
5. Using the Senses Chart, have students draw the parts of the human that hear, see, taste, smell and touch. Have them do the same for the cricket using the Cricket Senses worksheet.

Entomologist______________________

When I…

When I________________________________

(Write down something you do.)

I use _________________________ of my senses.

(How many?)

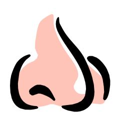
I use my sense of (circle the senses you use):

sight 

hearing 

taste 

touch 

smell 

Walking on Ears

Read-Aloud Cricket Poem

Anonymous

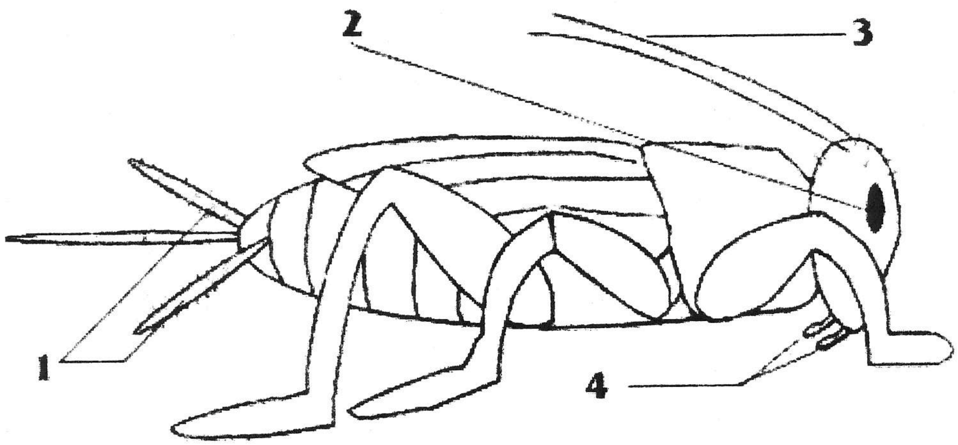
Voice 1	A cricket chirps with its wings.
Voice 2	Yes, that's how a boy cricket sings.
Voice 1	A cricket hears with its ears,
Voice 2	One here and one there.
Voice 3	A cricket sees
Voice 4	With its eyes, not its knees.
Voice 5	A cricket smells
Voice 6	With antennae long and round.

Voice 1	We see with our eyes.
Voice 2	We feel with our skin.
Voice 3	We smell with our nose.
Voice 4	We hear with our ears.
Voice 5	We sing and talk through our mouth.

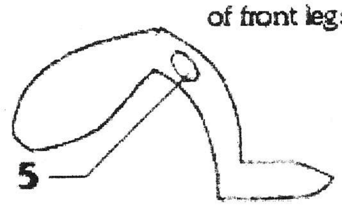
Voice 6	What if we sang with our arms
	And had ears on our knees,
	And smelled with our hands?
Voice 5	Would the world feel inside out?
	And upside down and wrong side out?
All	It may for us.
One Voice	But not for the cricket.
	(Imitate cricket sound.)

Entomologist________________________

Cricket Senses



On inside of front legs



1) TOUCH: hairs on cerci
2) SIGHT: eyes
3) SMELL: antennae
4) TASTE: palps and inside of mouth
5) HEARING: tympanum on inside of front legs

Entomologist______________________

Senses Chart

Hear	See	Taste	Smell	Touch
Human	Human	Human	Human	Human
Grasshopper	Grasshopper	Grasshopper	Grasshopper	Grasshopper

Directions: Under each sense box, draw the body part you use to hear, see, taste, smell and touch; and the body parts a grasshopper uses to hear, see, taste, smell and touch.

(To be used with Science Exploration 1-1)
Math – Activity 3

Hop to It!

Materials

- A live grasshopper
- Measuring tape and pencil
- Grasshopper and Student Jumps worksheet
- Compare Grasshopper and Student Jumps worksheet.
- Calculator and basic information on how to use division with a calculator
- An outdoor area to study the grasshopper jump and allow it to go free
- Clipboards

Activity

1. Have students hypothesize who can jump farther, the grasshopper or a human. Do the same for which can jump more body lengths.
2. Take the live grasshoppers to an outdoor area. Have students record on the worksheet, the length of the insect's body in inches and how far the grasshopper can jump. Record two more jumps. Set insects free once the activity is complete.
3. Have students repeat this procedure with humans recording human height and three human jumps.
4. After they complete the worksheets, help students compute average jump, and divide average jump by body length. Discuss who jumped farther compared to their body length—the human or the grasshopper. Compare to hypotheses.

Entomologist______________________

Grasshopper and Student Jumps

Grasshopper Jumps

Names:	
How long is the grasshopper?	inches
Length of grasshopper jump #1:	inches
Length of grasshopper jump #2:	inches
Length of grasshopper jump #3:	inches
Total distance jumped:	inches
Average length of jumps: (Divide total by 3.)	inches

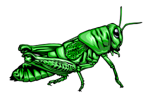
Student Jumps

Names:	
How tall are you?	inches
Length of student jump #1:	inches
Length of student jump #2:	inches
Length of student jump #3:	inches
Total distance jumped:	inches
Average length of jumps: (Divide total by 3.)	inches

Entomologist ________________________

Compare Grasshopper and Student Jumps

Grasshopper Jumps



Use a calculator to divide the average jump (_______) inches by the body length (_______) inches.

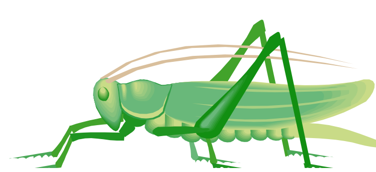
Our grasshopper can jump _______ times its own body length.

Student Jumps

Use a calculator to divide the average jump (_______) inches by the body length (_______) inches.

I can jump (_______) times my height.

Who jumped further compared to their own height or length? You or the grasshopper? Why?



(To be used with Science Exploration1-1)
Language Arts – Activity 4

Fascinating Facts

Materials

- Resource books including *I Didn't Know That Some Bugs Glow in the Dark and Other Amazing Facts about Insects,* by Claire Llewellyn
- Fun Fact Cards or index cards, and pencils
- Insect Fun Fact Sheet
- Materials for a classroom book (rings for index cards)
- Charade Cards
- Charade Cards with Examples

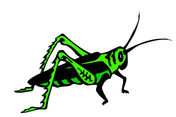
Activity

1. Share the Insect Fun Fact Sheet with the students. Inform them that as entomologists they are going to research insect facts. Read and discuss insect facts from *I Didn't Know That Some Bugs Glow in the Dark and Other Amazing Facts about Insects*.
2. Have "student entomologists" research and find fun insect facts for themselves.
3. Once they find a fact, have the student write it on an index card exactly as in the published book; the book name and page number must be written on the bottom of the fact card to verify the source of the knowledge. (Teacher or classroom helpers may want to verify the cards. Charade cards are included if children are not developmentally ready to research their own facts.)
4. When all students have written one or two facts, the bibliography and their names on the cards, collect the cards and place them in a pile face down.
5. Explain how to play the game of charades with students acting out the facts on the cards.
6. As each student acts out a fun insect fact, encourage other students to guess the fact. (The cards may be illustrated by the students and made into a book using rings.)

Fun Fact Cards

Did you know…

Did you know…



Insect Fun Facts

1. Some insects can sing.
2. There are more than 1,000,000 different species of insects in the world.
3. Insects wear their skeletons on the outside of their bodies.
4. Insects were the first animals that were able to fly.
5. Insects are cold-blooded.
6. Some adult insects only live a few hours.
7. Some insects smell with their antennae, or feelers.
8. Insects can see, smell and hear some things that humans cannot.
9. Some insects can dance.
10. Some insects smell bad.
11. Monarch butterflies can migrate over 2,000 miles.
12. Many insects can swim.
13. Some insects taste with their feet.
14. Dragonflies have as many as 30,000 lenses in each eye.
15. A fossil dragonfly that lived two hundred million years ago had a wingspan of over two and one-half feet long.
16. The longest insect living today is a tropical stick bug and is thirteen inches from end to end.
17. A fly has been recorded to fly 90 miles per hour.
18. Male mosquitoes beat their wings 450 to 600 times per second.

19. Cockroaches are believed to be the oldest group of insects dating back 300 million years.

20. The fastest running insect is the cockroach, which can move almost a foot per second.

Charade Cards

Some insects sing.	Insects are cold-blooded.
Some insects smell with their antennae.	Some insects can dance.
Some insects smell bad.	Many insects can swim.
Some insects taste with their feet.	Some insects catch their food in mid-air.

Charade Cards

Some insects have hair.	Dragonflies have the largest eyes of all insects.
Some insects' ears are on their abdomens.	Some insects' ears are on their legs.
Some insects can walk upside down.	Some insects can walk on water.
Some insects can breathe under water.	Some insects fly hundreds of miles away and back.

Charade Cards with Examples

Some insects sing. (cricket)	Insects are cold-blooded.
Insects smell using their antennae.	Some insects can dance. (honeybee)
Some insects smell bad. (stink bug)	Many insects can swim. (diving beetle)

Charade Cards with Examples

Some insects taste with their feet. (butterfly)	Some insects catch their food in mid air. (dragonfly)
Some insects have hair. (bumblebee)	Dragonflies have the largest eyes of all insects.
Some insects can walk upside down. (flies)	Some insects can walk on water. (water strider)

Charade Cards with Examples

Some insects can breathe under water. (mosquito larva)	Monarch butterflies fly hundreds of miles.

(To be used with Science Exploration 1-1)
Language Arts – Activity 5

Insect Riddles

Materials

- One copy of *My Insect Riddles* for each student
- Pencils

Activity

1. Ask for volunteers to read each riddle.
2. As the riddles are read, have students determine which insect has the given characteristics.
3. Write the correct spelling of the insect on the board for the students to copy or have the students write the name of the insect on the line given in each box using their own spelling. (The students may wish to draw very small illustrations next to each insect name.)
4. Have students cut apart the boxes and staple them to make their own small riddle book.

Answer Key:

Riddle 1 – ant

Riddle 2 – ladybug

Riddle 3 – bee

Riddle 4 – butterfly

Riddle 5 – grasshopper

Riddle 6 – praying mantis

Riddle 7 – termite

My Insect Riddles  Entomologist________________	When you are on a picnic, I'm almost always around. Sometimes on the food you eat, sometimes on the ground. Who am I? ________________________
I have black dots, but I'm mostly red. I'm very tiny from my feet to my head. I'm a cute little insect and children like me. That's enough clues. What can I be? ________________________	I think I'm sweet, though you may not. I make honey an awful lot. I sting sometimes; then you don't like me. Do you know what I might be? ________________________
Everyone thinks I'm a pretty sight. My colors are the best when I'm in flight. I love flowers and a sky of blue. I'm the prettiest insect; yes, it's true. Who am I? ________________________	I love to hop and my color is green. I'm one of the best insects you've seen. Spiders like me; birds do too. Lizards and mice will eat me, but not you! Who am I? ________________________
I'm green with very long legs and I lay 10-400 eggs. I blend in with leaves and grass that's green. I'm one of the most interesting insects you've seen. Who am I? ________________________	I'm not always welcome in your home. People don't like me when I roam. I eat wood in a home, bark or tree. What do you think? Can you name me? ________________________

Science Exploration 1-2

Insect or Not an Insect

Essential Knowledge

- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Describe some of the characteristics of insects.
- Describe some differences between insects and other arthropods.

Materials

- Dragonfly pieces
- Models of insects and other arthropods
- Student journals and magnifying lenses
- "Insect or Not an Insect Game Cards" (cut apart)
- Worksheet: "What Makes a Bug an Insect"
- Book, *What Makes an Insect?,* by Lynn M. Stone

Background

The largest group of animals is the group of arthropods. If an animal has a segmented body, at least six jointed legs and an exoskeleton, it is an arthropod. Some of the animals that belong in this group of arthropods are spiders, crabs, lobsters, centipedes and insects. Arthropods are found everywhere on earth—in the air, water, trees and soil and in all types of habitats, such as the mountains, deserts, oceans and prairies.

What distinguishes insects from other types of arthropods? Insects are the only arthropods that have three body parts—head, thorax and abdomen; six legs, a pair of antennae, two compound eyes and/or two or three simple eyes and usually one or two pairs of wings. Insects are very small compared to other animals and are the only arthropods that are able to fly under their own power.

Spiders, ticks, mites and scorpions are not insects since they have eight legs, two main body parts, simple eyes, no antennae and no wings. Crabs, lobsters and centipedes are not insects because they have more than six legs and other distinguishing characteristics.

By focusing on certain animal characteristics, entomologists are able to determine the group to which an animal belongs; therefore, distinguishing insects from their close relatives.

Class Time

Exploration Part I

Engaging the Students

- Hand out the different parts of the dragonfly to different students.
- Facilitate a discussion on parts of an insect while students assemble the dragonfly.
- Ask students what "critters" may look like insects but aren't insects. (For example, spiders and mites have eight legs and two body parts.)
- Find out what students know and would like to find out about insect relatives.
- Post results.

Investigations – Students will:

- Work in cooperative groups.
- Examine insect and arthropod models using magnifying lenses and record their observations in their journals.
- Draw their insects and other arthropods and label parts they recognize.
- Write short descriptions noting the differences between the insects and other arthropods.

Sharing and Summarizing

- Have each group share what they have observed with the class and students record any new information in their journals.

Exploration Part II

Engaging the Students

- Give each group of students a set of "Insect or Not an Insect Game Cards" and the tool, "What Makes a Bug an Insect?," (Students will assemble this new tool and practice using it.)

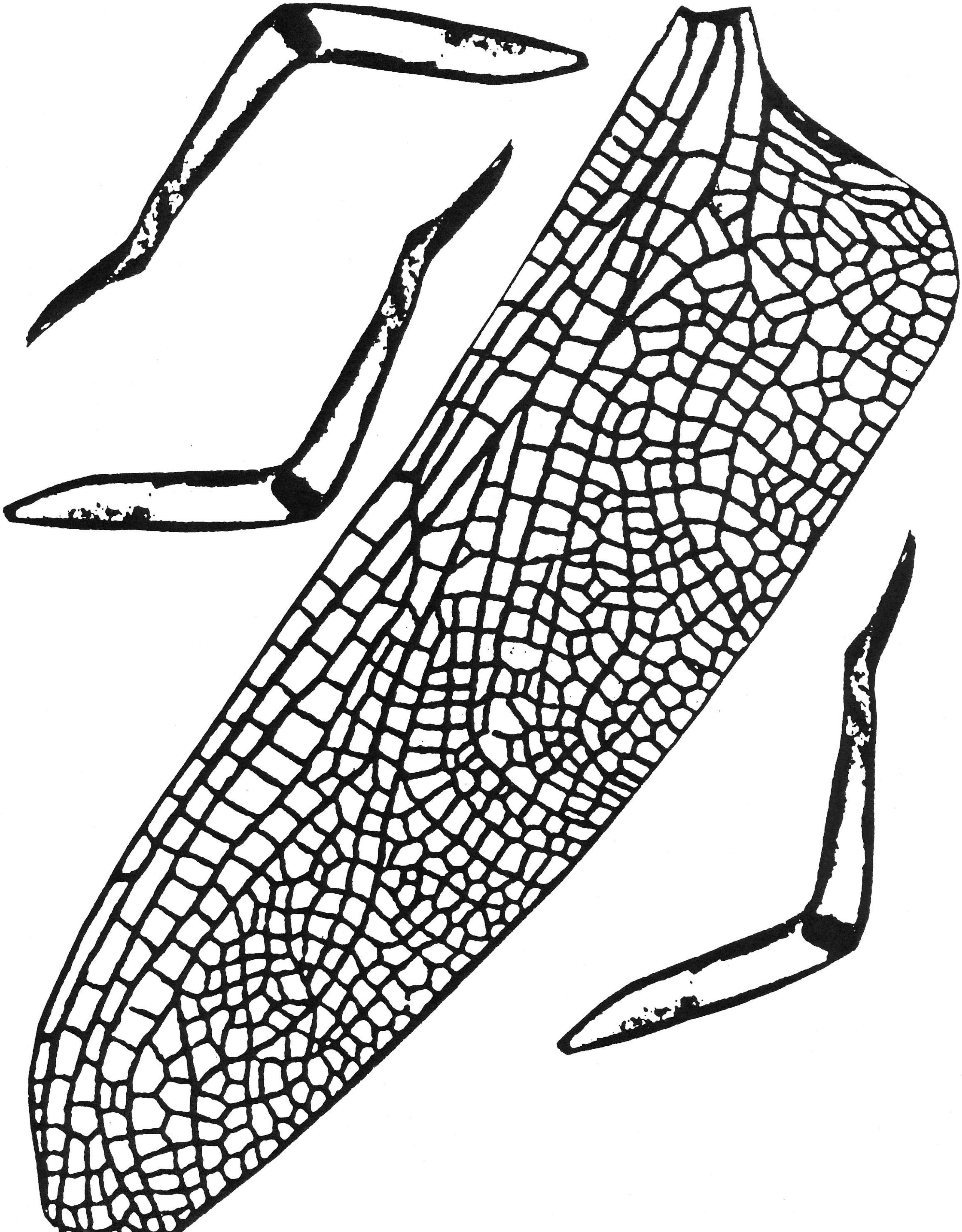
Investigations

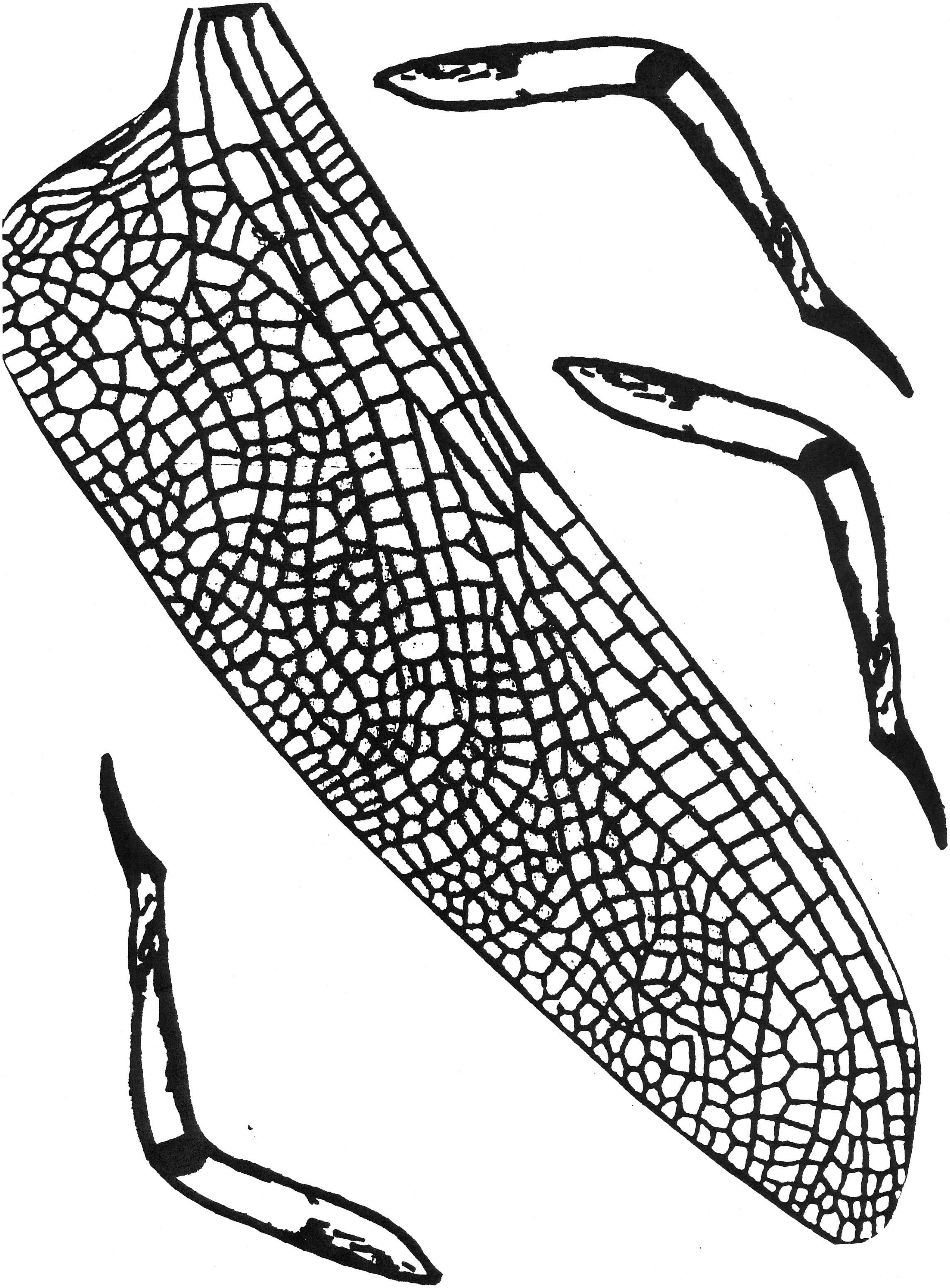
Students will:

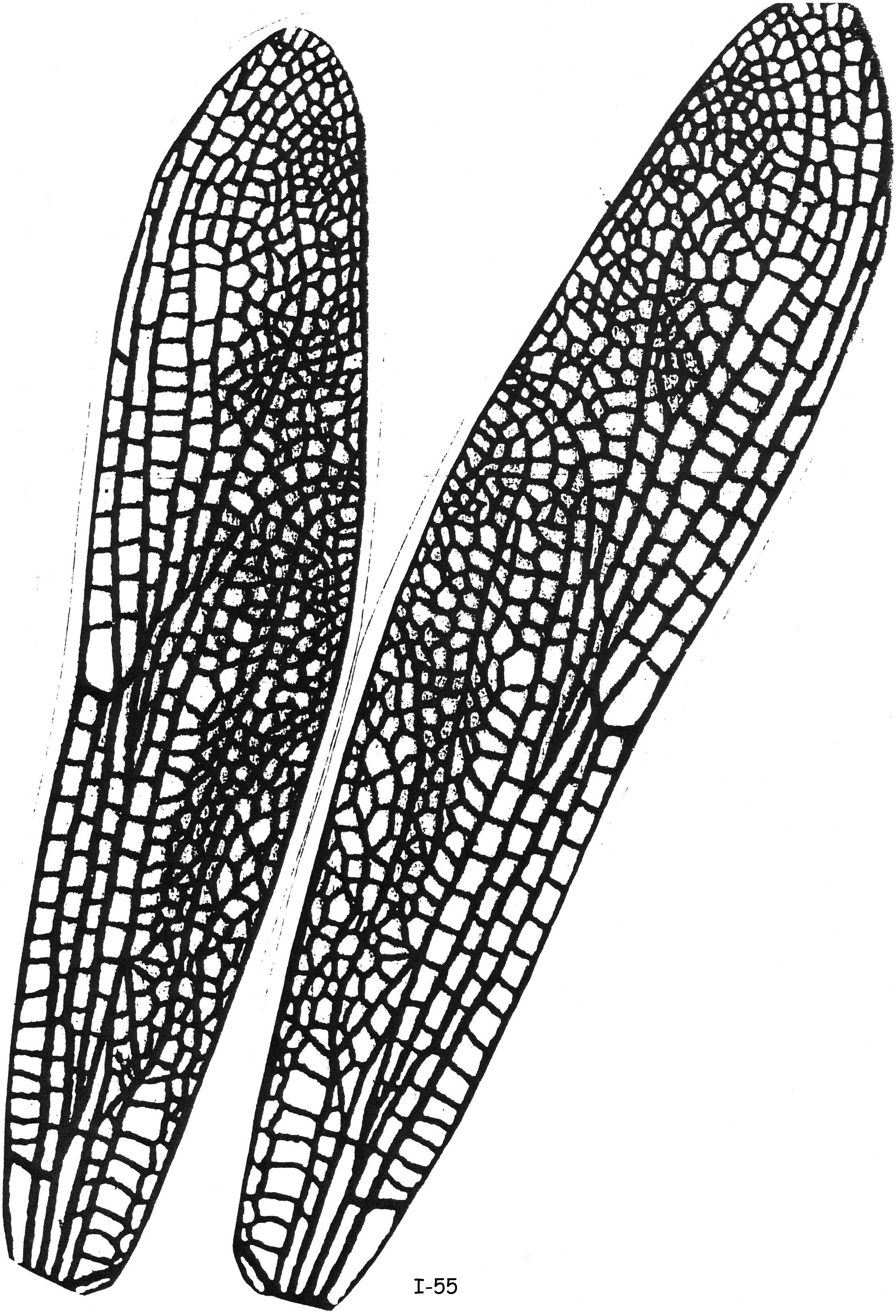
- Work in cooperative groups.
- Sort the pictures of arthropods (game cards) into insects and non-insects using the tool, "What Makes a Bug an Insect?," to help determine which arthropods are insects.
- Record what they observe.

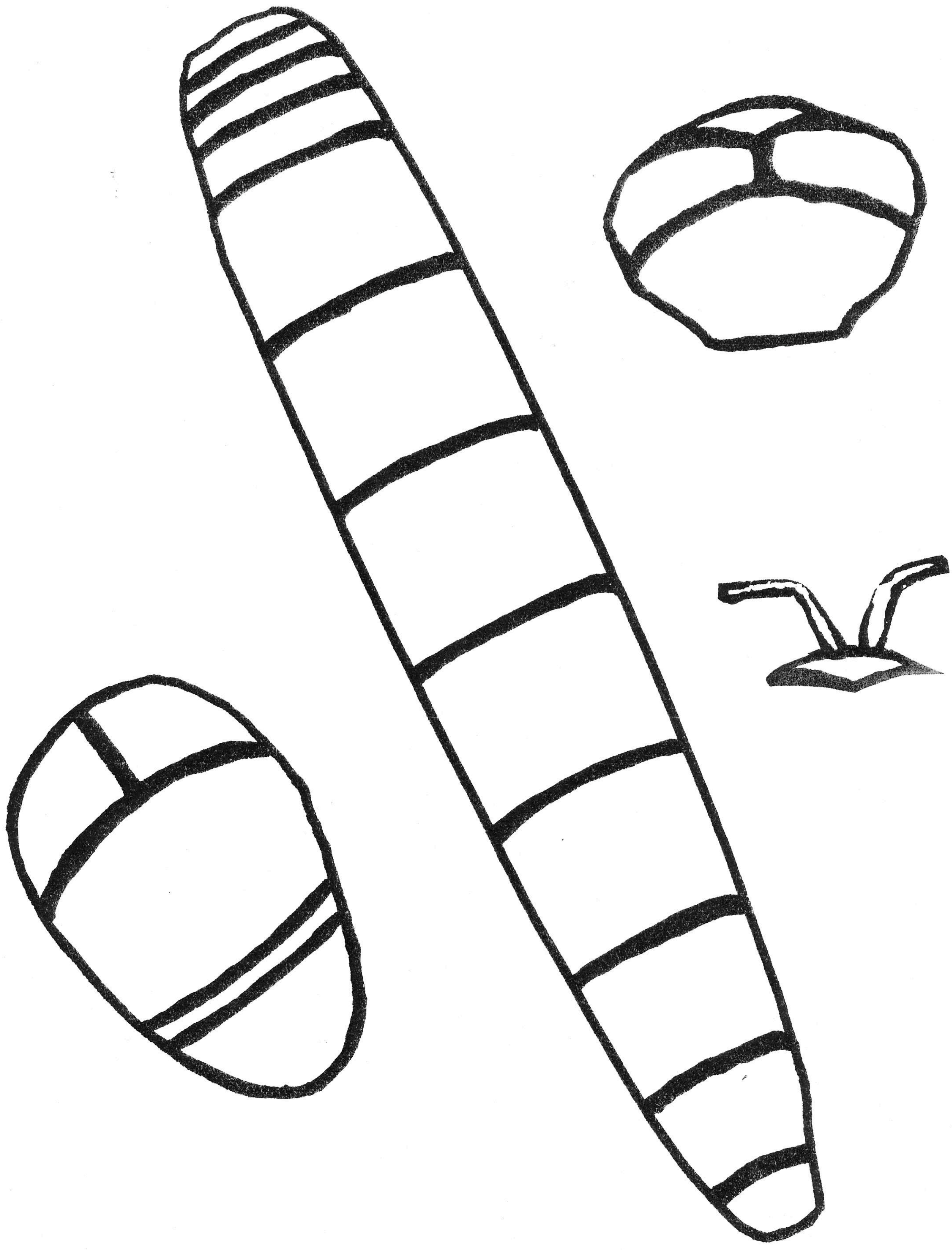
Sharing and Summarizing

- Have groups share what they have observed with the class and record new information in their journals.
- Post their findings and compare these with the postings from Lesson 1.
- Revisit the roles of an entomologist and record any new ideas on the model.
- Read book, *What Makes an Insect?,* and have students add any new words to the dictionary in the back of their journal.

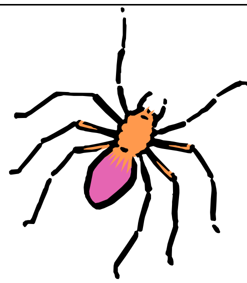
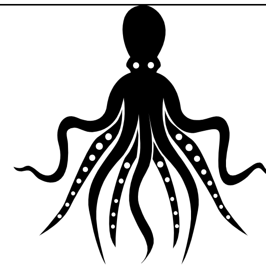


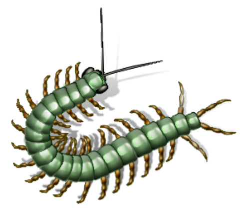






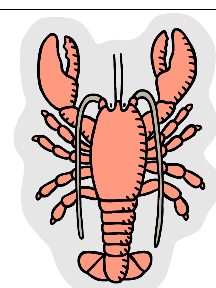
Insect or Not an Insect
Game Cards

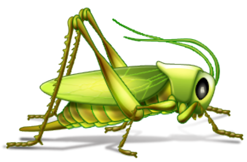
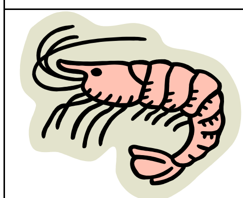
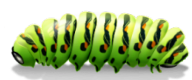
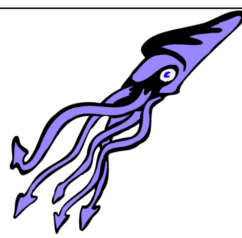









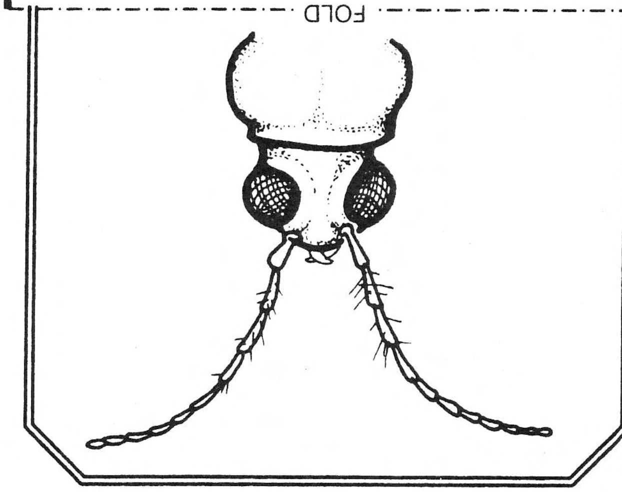
Insect or Not an Insect
Game Cards

WHAT MAKES A BUG AN INSECT?

(Lift flap)

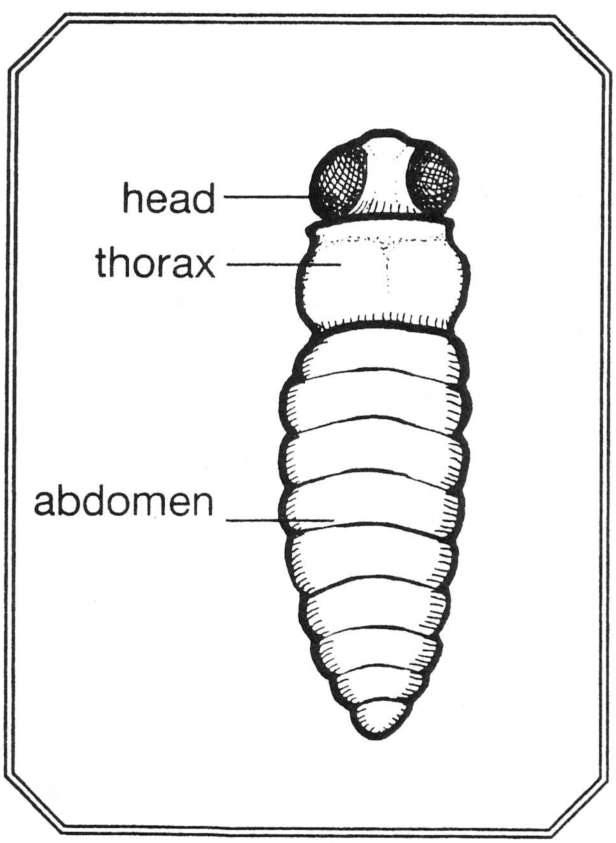
FOLD



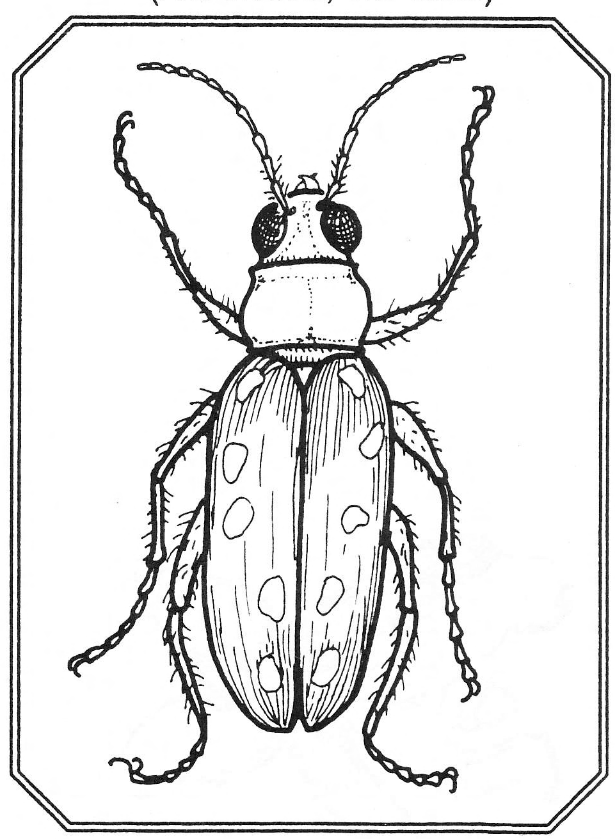
Does it have feelers on its head?

FOLD

Does its body have three parts?



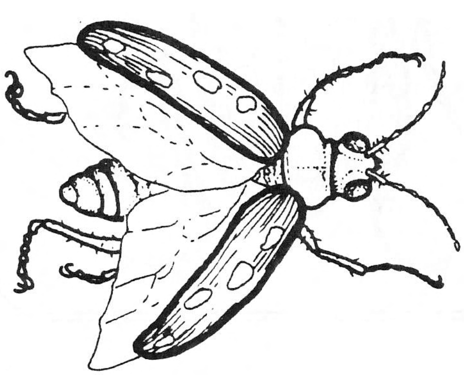
Does it have six legs?
(No more, no less)



FOLD

Then it's an insect!

(And it probably has wings, too...)



Science Exploration 1-3

Insects in the Schoolyard

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.

Learner Outcomes

Students will be able to:

- Distinguish between insects and other arthropods.
- Record observations in journals.

Materials

- Hula hoop, string or meter sticks for each group
- Magnifying lenses
- Bug boxes
- Venn diagram example
- Science journals
- Song, *Insects All Around,* Anonymous
- Signs of Insects
- Venn diagram
- Activity 1: Favorite Insect Survey

Background

Students may be familiar with some insects in their homes and yards, but not realize how many different insects are present in their very own schoolyard. Insects may be found in the lawn, among shrubs, around trees, and even in the cracks of sidewalks. A habitat is the environment in which an organism lives. Insect diversity increases where a number of different habitats exist. Certain insects may be present in only one habitat while others may be found in several different habitats. In wetland areas, insects are often used to determine if the habitat is healthy. The presence of certain species that have little or no tolerance for pollution indicates that the wetland is healthy.

Class Time

Engaging the Students

- Visit the schoolyard while singing *Insects All Around.*
- Discuss the different habitats in the schoolyard (grassy, mulched, wooded, and/or paved areas).
- Brainstorm the kind of insects and other arthropods that might exist in the schoolyard.
- Using "hula hoops," string or meter sticks, have each group of students mark off an area in the schoolyard. This is their lab station. (Teacher may want to do this ahead of time.)

Investigations

Students will:

- Use magnifying lenses to look for insects and other arthropods in their lab station.
- Use bug boxes to catch insects found in their lab station.
- Record and/or draw the different animals found. Mark which ones are insects.
- Look for signs of insects (see the sheet "Signs of Insects") in their stations. Record this information.
- Repeat in another habitat.

Sharing and Summarizing

- After students share their observations, facilitate a discussion on characteristics of the "critters" (for example, how do they distinguish insects from non-insects?) and the habitats where they found them.
- Record this information on the board using a Venn diagram to show similarities and differences of insects and non-insects.
- Have students add new information to their journals and new ideas to the entomologist model.
- Activity 1: Favorite Insect Survey

Insects All Around
(Tune: Twinkle, Twinkle, Little Star)

Ladybugs and butterflies,

Buzzing bees up in the sky.

Teeny, tiny little ants,

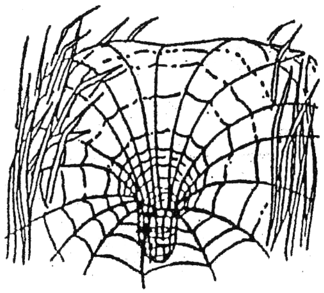
Crawling up and down the plants.

Many insects can be found

In the sky and on the ground.

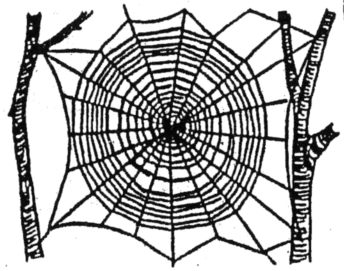
WEBS, EGGS, AND COCOONS

WEBS



funnel web spiders

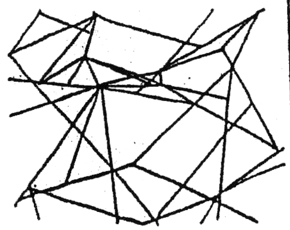
hammock spiders



orb spiders

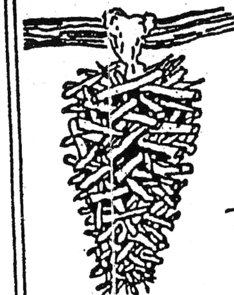
webworms (wide v-winged moths)

tent caterpillars (wide v-winged moths)

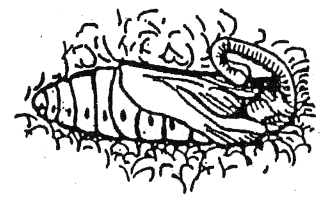


comb clawed spiders

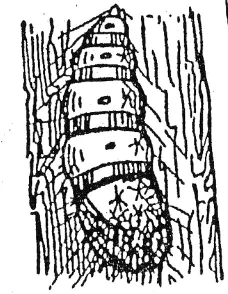
COCOONS AND CHRYSALIDES



bagworm moths (narrow v-winged moths)

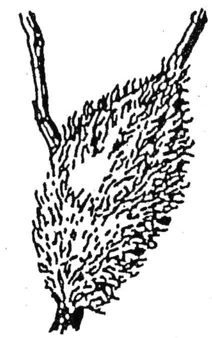


hawk moths (wide v-winged moths)

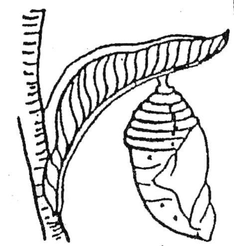


gypsy moths (wide v-winged moths)

polyphemus moths (large silkworm moths)

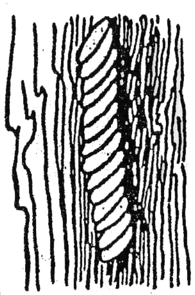


cecropia moths (large silkworm moths)

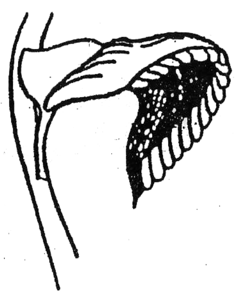


monarch butterfly larvae (other large butterflies)

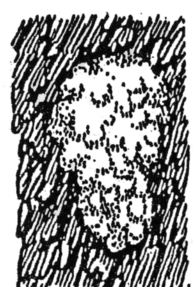
EGGS



cicadas



katydids

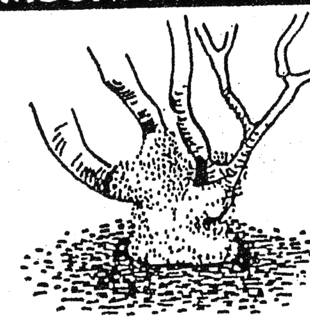


gypsy moths

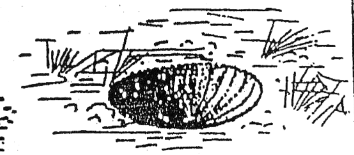
mantids

MOUNDS AND PITS

ants

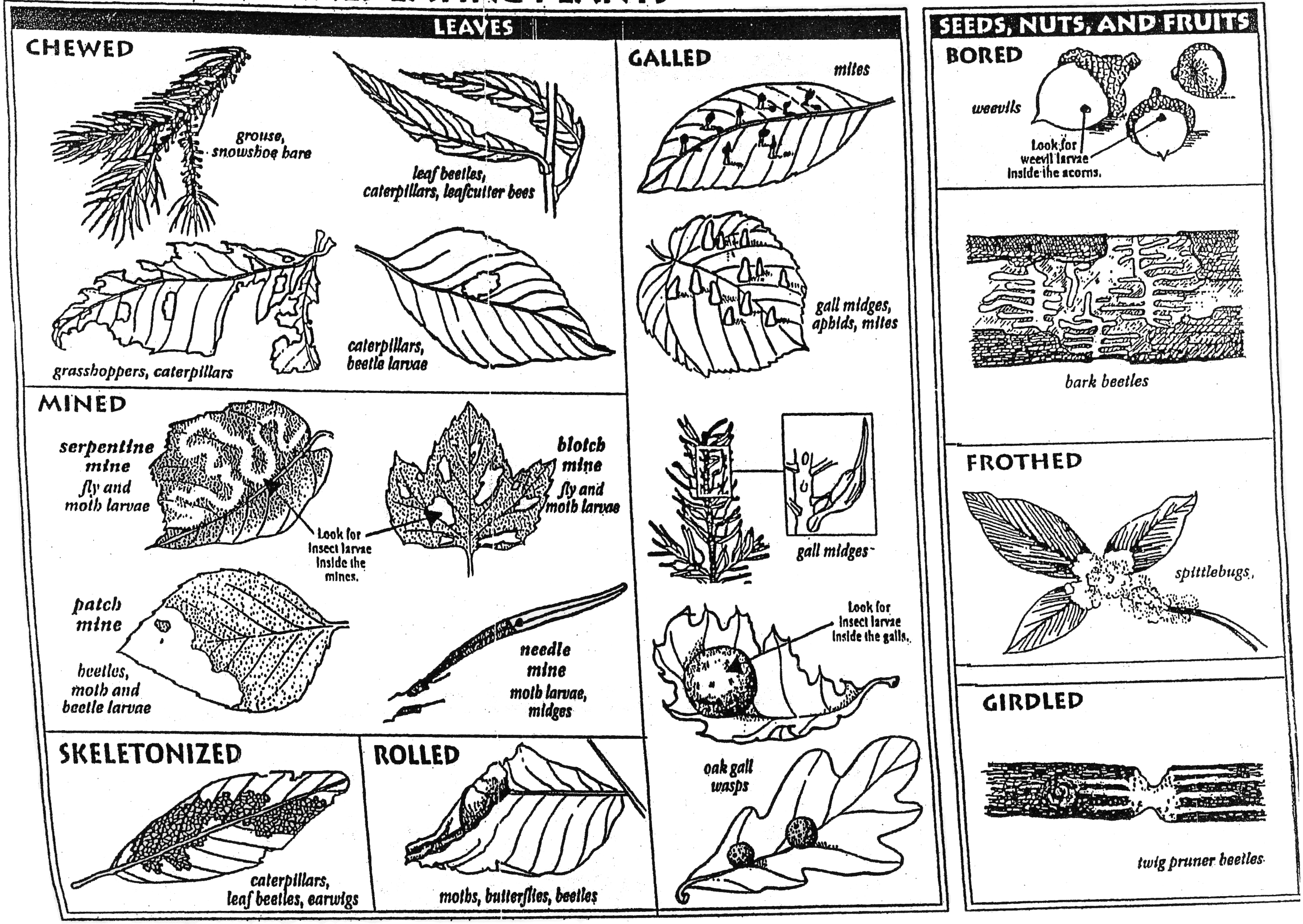


termites



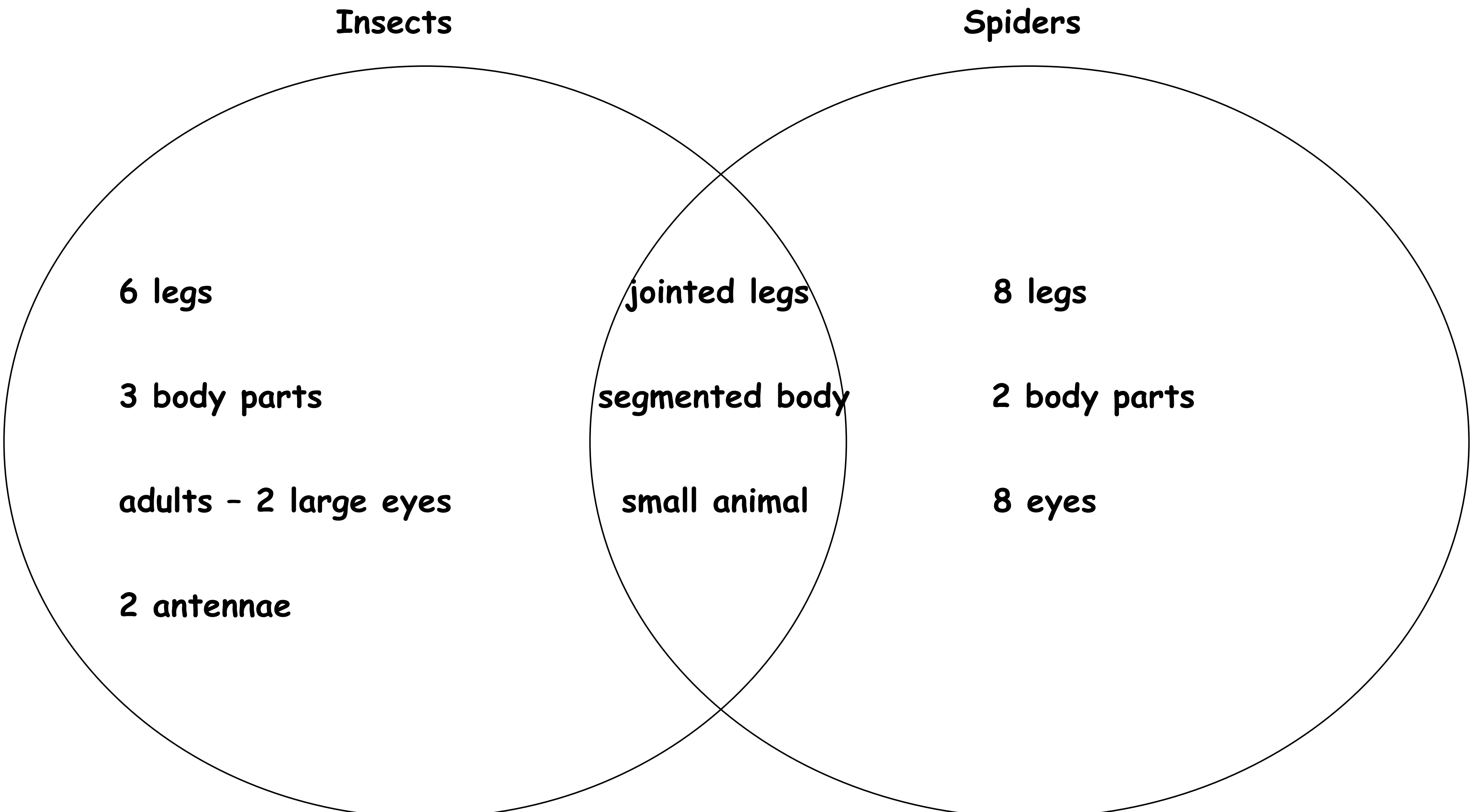
ant lions

SIGNS OF ANIMALS EATING PLANTS



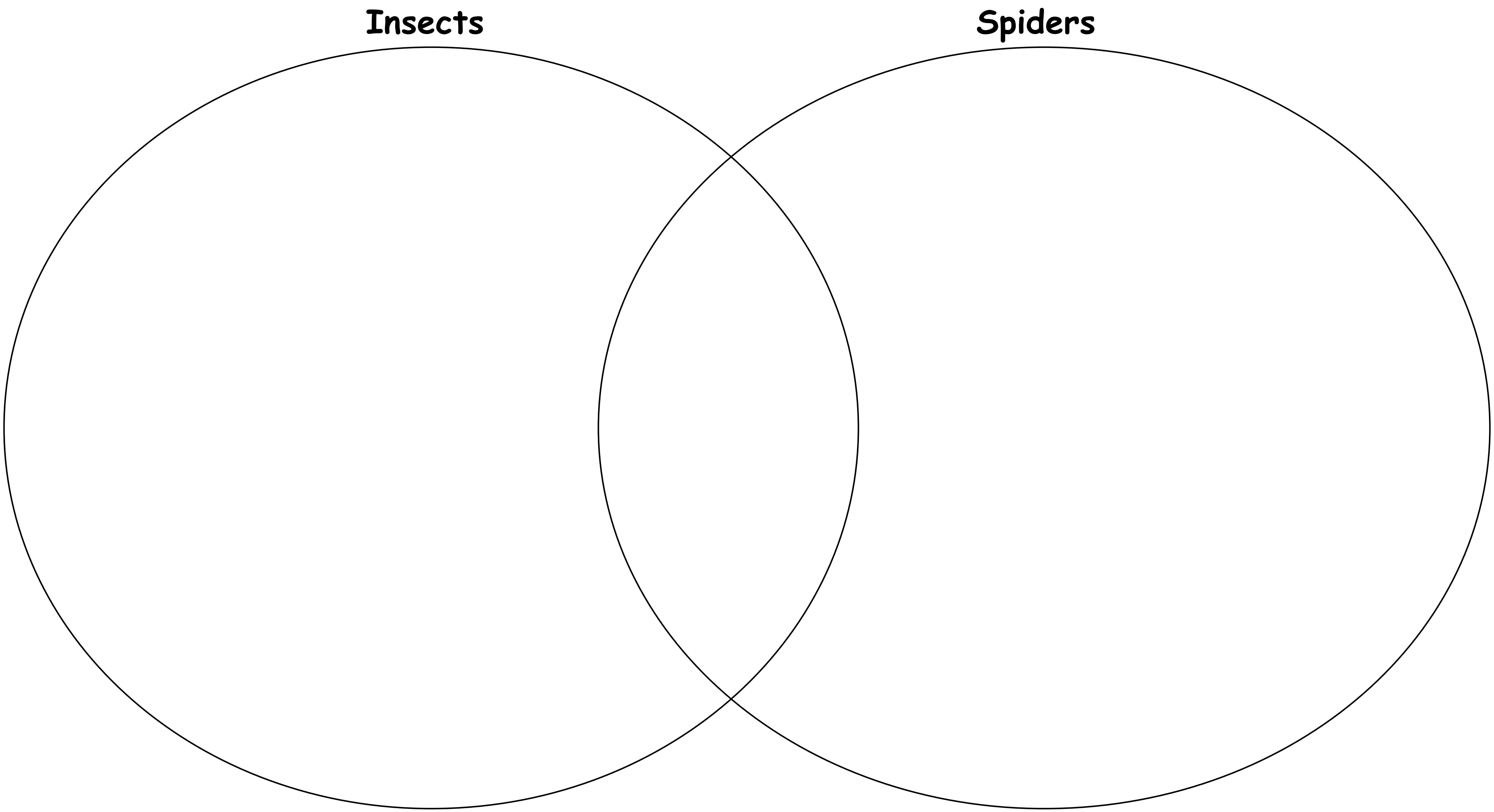
Venn Diagram

Entomologist________________________________



Venn Diagram

Entomologist___________________________________



(To be used with Science Exploration 1-3)
Math - Activity 1

Favorite Insect Survey

Materials

- Insect Survey sheets
- Pencils
- Chart paper

Activity

1. Explain to students that they will be surveying their family members to find out which insect this particular group of people would choose as their "favorite insect."
2. Discuss that you will be compiling the information using a simple tally graph to determine which insect is the favorite.
3. Send the *Favorite Insect Survey* home with the students as homework.
4. In advance, prepare a list of common insects on chart paper.
5. As students return completed surveys, tally marks are placed next to each insect that receives a vote for "favorite insect."
6. When all results have been tallied, have students count the number of tallies next to each insect to determine the "favorite insect."
7. Discuss with students which insect had the most votes, the least, etc.
8. Discuss with students why they think the "favorite insect" is the overall favorite.

Favorite Insect Survey

Entomologist________________

Ask your friends and family members to tell you their favorite insect. Record their name and answer in the space provided. Be sure to return your survey to school.

Friend/Family Member	Favorite Insect

Science Exploration 2-1

Sorting "Critters"

Essential Knowledge

- Insects are divided into groups according to similarities and differences.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcome

Students will be able to:

- Sort objects and "critters" into groups.

Materials

Items such as beans, coins, Legos, buttons, bolts and screws
Plastic models of insects and their relatives
Science journals
Book, *Why Am I an Insect?*, by Greg Pyers
Book, *Life Science Insects*, by Janice Parker

Background

Organization can help simplify our lives. Librarians group books, school administrators classify students, cooks sort kitchen utensils, all according to specific criteria. Grouping items using common characteristics makes learning about these items easier.

The science of classification or sorting is called taxonomy. Scientists sort living organisms according to how closely they are related. This important practice allows scientists to group organisms from a most general way to a very specific classification.

There are more than a million different species of insects, making it impossible for anyone to learn about them all. A scientist may need to know only general characteristics of insects to be able to differentiate them from other "critters." Another may be studying a topic such as the pollination of a plant by a particular insect, only needing information on that particular species of insect. Using insect classification, one would find information without searching through a million species, a daunting task.

<u>Class Time</u>

Exploration Part I

Engaging the Students

- Introduce the concept of classification explaining that as apprentice entomologists, their study of insects will be easier if, like entomologists, they can sort insects into groups.
- Have students practice by brainstorming characteristics (gender, hair color, jeans/no jeans, etc.) they could use to sort each other.
- Select volunteers willing to be "sorted."
- Work through the characteristics. (For some, ask volunteers to move from group to group; for others, ask classmates to determine the groups.)
- Record results on the board and facilitate a discussion of other characteristics and whether they could be used when sorting things other than themselves.

Investigations

Students will:

- Divide up into working groups using one or more of their criteria if possible.
- Sort a selection of items such as beans, coins, Legos, buttons, bolts and screws, or a mix.

Sharing and Summarizing

- Have each group select a reporter (who stays with their group's work).
- Gather the class around each group's work to look at how the objects were sorted and ask the students if they can identify the criteria used. (The reporter can confirm or deny and then share the criteria the groups used.)
- Accept any criteria that they are able to explain.
- Ask if the class agrees with the placement of the objects in the groups and then have them sort the items into smaller groups using more specific criteria.

Exploration Part II

Engaging the Students

- Give each group models of insects and their relatives.

Investigations – Students will:

- Select characteristics used to sort and sort the models accordingly,
- Record (write or draw) in their journal the characteristics and which "critters" belong in each group.

Sharing and Summarizing

- Have the reporters share with the class the characteristics the groups used to sort their "critters".
- Record the answers on the board.
- Ask students if they could sort the "critters" into smaller groups using more specific criteria.
- Have them record (write or draw) the characteristics used in their journals.
- Read books, *Why Am I an Insect?* and *Life Science Insects*, to class.

Science Exploration 2-2

Sorting Common Insects

Essential Knowledge
- Entomologists are scientists who study insects.
- Insects are divided into groups according to similarities and differences.

Skills
1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes
Students will be able to:
- Sort insects into groups.
- Describe some characteristics that are used by entomologists to sort insects.
- Name some additional roles of an entomologist.

Material
- Sets of insect pictures of the four orders of insects:
  - Bees, wasps and ants
  - Butterflies and moths
  - Beetles and weevils
  - Grasshoppers and crickets
- Science journals and entomologist model
- Insect collection
- Insect orders posters

Background
The science of classification is an important practice used by scientists that allows them to sort living organisms according to how closely they are related. This system is organized from the most general to the most similar:

Kingdom – Phylum – Class – Order – Family – Genus – Species

For instance, the group of insects is a member of the Animal Kingdom, the Phylum Arthropod and the Class Insecta. Entomologists sort the members of the Class Insecta further into more specific groups called orders.

Some of the more common orders consist of the following insects:

- Beetles and weevils
- Butterflies and moths
- Bees, wasps, and ants
- Grasshoppers and crickets

Certain physical characteristics are used to classify these insects:

- Beetles and weevils are easily recognized because their forewings meet in a straight line.
- Butterflies and moths have wings covered with overlapping scales.
- Bees, wasps and ants have slender waists.
- Large back legs are characteristic of grasshoppers and crickets.

To sort insects further to the level of genus and then species can be very difficult. Being able to sort insects to the level of orders is an accomplishment for "apprentice entomologists."

<u>Class Time</u>

Exploration Part I

Engaging the Students

- Ask students to name some familiar insects.
- Tell students that today as apprentice entomologists, their job is to sort insects into groups called orders.
- List some general characteristics that entomologists use to sort insects (body shape, appearance, number of visible wings, shape of legs, etc.) on the board.

Investigation

Students will:

- Divide into groups, perhaps using different characteristics than used in Science Exploration 2-1.
- Study the insect pictures.
- Record in their journals characteristics that they will use to sort insects and sort insects accordingly.

Sharing and Summarizing

- After students share the criteria they used, facilitate a discussion comparing how they sort the insects and how an entomologist might sort them.
- Have students list the insect orders used in this lesson and write or draw distinguishing characteristics of each order in their journals.
- Add to the entomologist model additional roles that an entomologist might perform.

Exploration Part II

Engaging the Students

- Hand out insect collections.
- Hang posters of the four orders of insects listed in the background section.

Investigations

Students will:

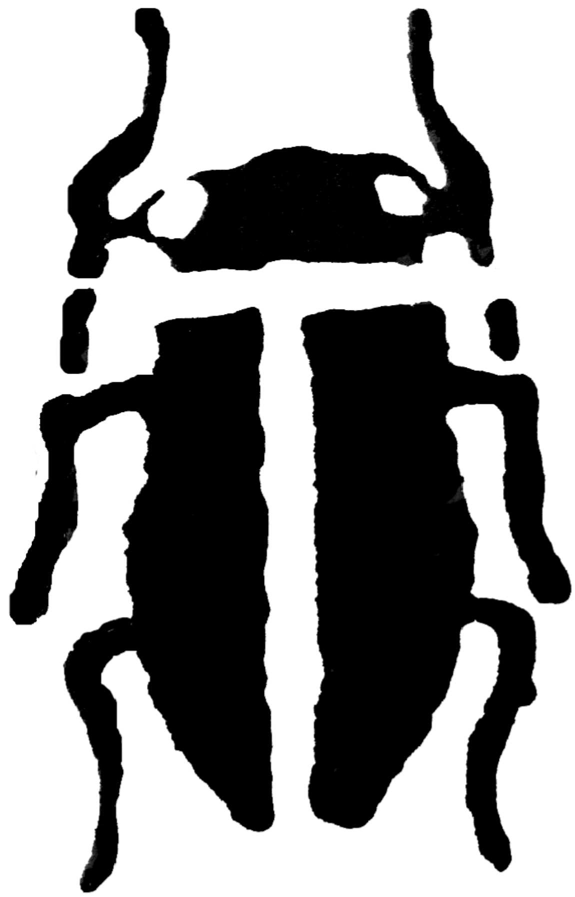
- Work in cooperative groups.

- Study the insect collection and/or models to decide which insects belong in one of the orders described on the posters.
- Record their findings in their journals.

Sharing and Summarizing

After students share their observations with the class, facilitate a discussion of how they determined in what order to place the insects.

Pretty Lined Beetles



<u>Characteristics</u>

Straight line down back

Hard front wing covers

Beautiful Wings

Characteristics

Four scale-covered wings

Large compound eyes

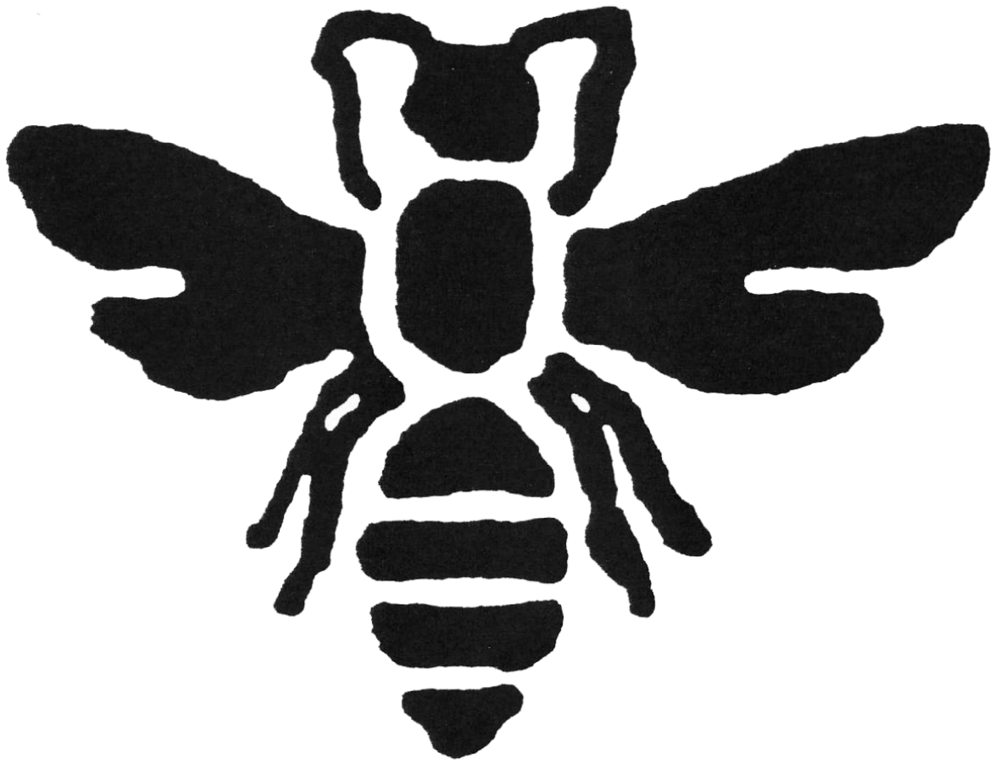
Musical Insects

Characteristics

Large bent legs

Thickened front wings when present

Stinging Insects



<u>Characteristics</u>

Narrow waists

Stinger at end of body

Four clear wings when present

Science Exploration 2-3

Illinois Common Insects

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Describe some of the characteristics of insects by studying pictures and preserved insects.
- Sort insects into orders.
- Record observations in journals.

Materials

- Insect collection
- Pictures of insects
- Magnifying lenses
- Science journal
- Activity 1: Insect Orders Bingo (cards and pieces)
- Activity 2: Trading Cards (Insect House for Collector Cards, and cards)
- Insect Orders Assessment
- Posters of each order

Background

There are many orders of insects in Illinois and on the Fermilab site. Approximately ninety percent of insects found in Illinois will belong in one of eight common orders. These orders include the four orders that were studied in Exploration 2-2.

- Bees, wasps and ants
- Beetles and weevils
- Butterflies and moths
- Grasshoppers and crickets

The other four orders are:

- Hoppers and cicadas (Some scientist group these with true bugs)
- Flies and mosquitoes
- Dragonflies and damselflies
- True bugs

Certain characteristics are used to sort these insects:

- The wings of hoppers and cicadas meet to form a tent over their backs.
- Flies and mosquitoes have only a single pair of visible wings.
- Dragonflies and damselflies have very slender bodies and two pairs of wings with many veins.
- The top half of true bugs' wings are hardened while the bottom half are membranous. They fold over each other making it appear as if they have an "X" on their backs.

(Additional information on the common insect orders may be found in *Extra Resources*.)

Class Time

Engaging the Students

- Hand out insect collections and/or pictures of different insects and magnifying lenses.
- Hang posters of the eight orders of insects listed in the Background section.
- Facilitate a discussion of characteristics that are listed on the posters of the new orders (those not used in Exploration 2-2).

Investigations

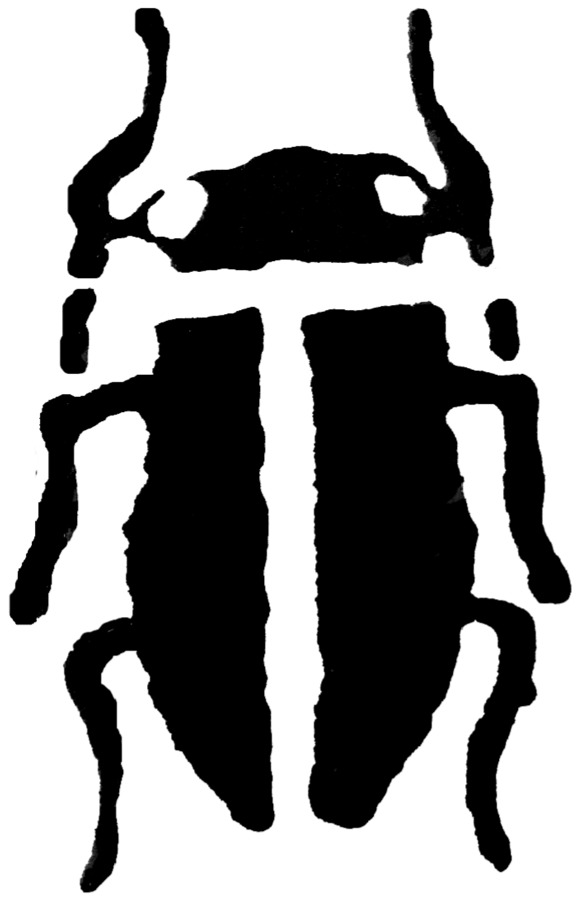
Students will:

- Work in cooperative groups.
- Study the insect collection and/or pictures and determine which of these insects belong in one of the orders described on the posters.
- Record their findings in their journals.

Sharing and Summarizing

- After students share their observations with the class, facilitate a discussion of how they determined in what order to place the insects and have students add any new information to their journals.
- Activity 1: Insect Orders Bingo
- Activity 2: Trading Cards
- Share with students that many of these insects can be observed in their yards, in the schoolyard and at Fermilab.
- Have students complete the Insect Orders Assessment worksheet.
- Hang posters of each order.

Pretty Lined Beetles

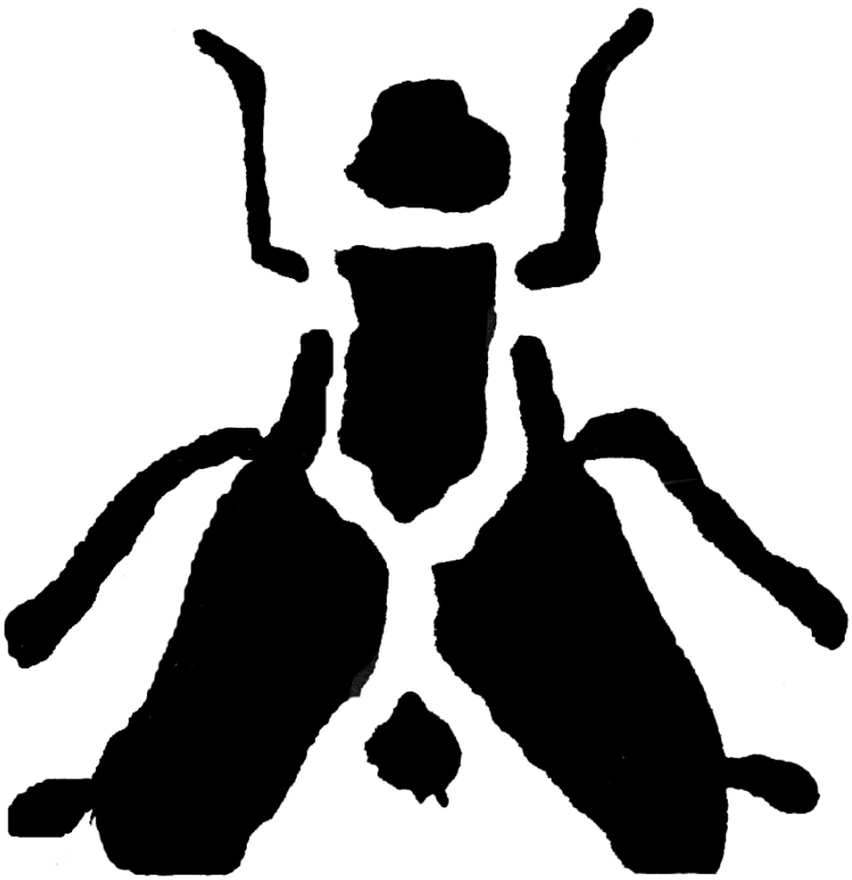


<u>Characteristics</u>

Straight line down back

Hard front wing covers

Fast Flyers

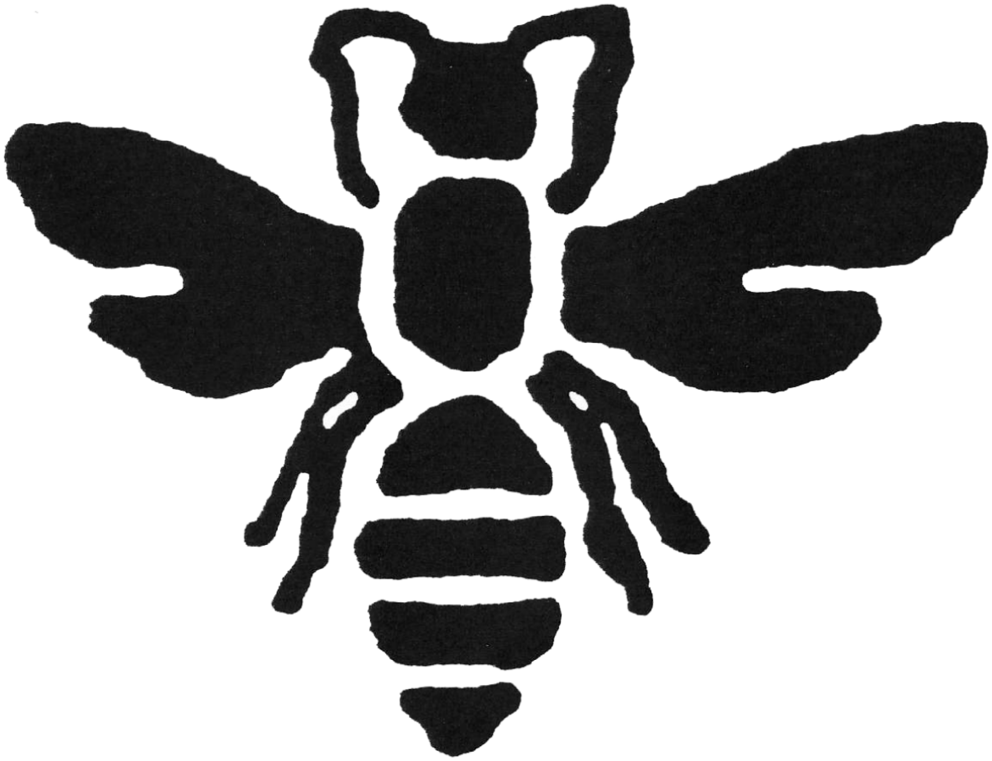


<u>Characteristics</u>

One pair of developed wings

Two large compound eyes

Stinging Insects



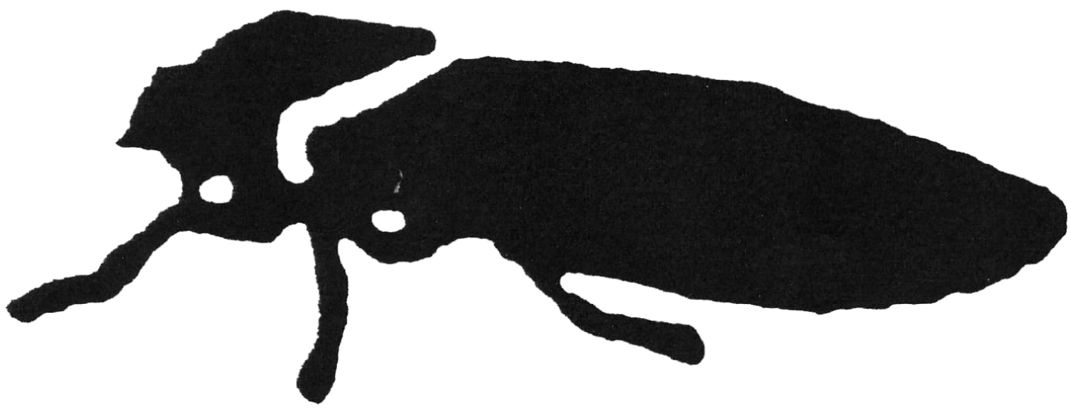
<u>Characteristics</u>

Narrow waists

Stinger at end of body

Four clear wings when present

Tent Backs



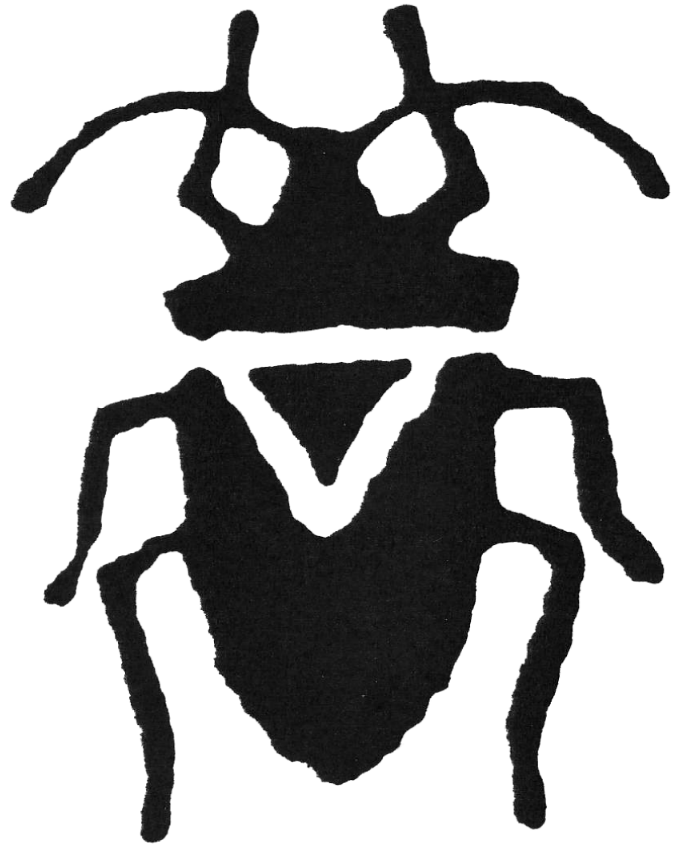
Characteristics

When folded across back,

Wings tent-shaped

Beak attached to back of head

X-cellent True Bugs



Characteristics

X on back

Only half of front wings hardened

Beak attached to front of head

Musical Insects

<u>Characteristics</u>

Large bent legs

Thickened front wings when present

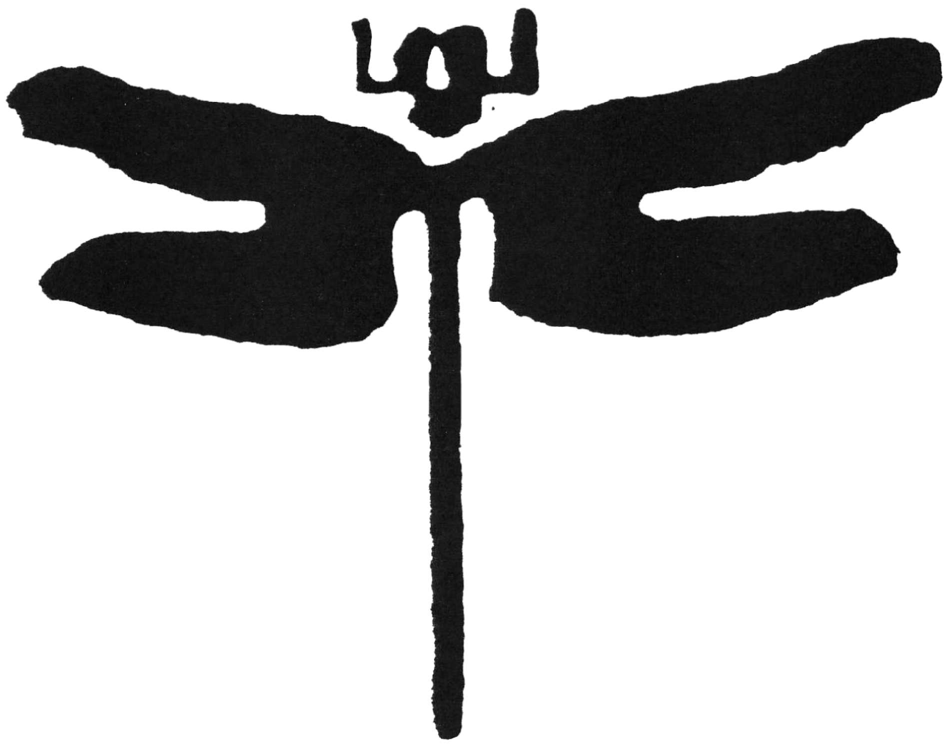
Beautiful Wings

<u>Characteristics</u>

Four scale-covered wings

Large compound eyes

Water Wingers



<u>Characteristics</u>

Narrow body

Four long wings with many veins

Very large compound eyes

(To be used with Science Exploration 2-3)
Activity 1

Insect Orders Bingo

Materials

- Copies of the five different Bingo cards – one card per student
- Copy of the cards for calling the orders – cut apart
- Manipulatives for students to use as markers

Activity

1. Explain to the students that they will be playing a Bingo game that will help them to identify eight common orders of insects.
2. Distribute the bingo cards and markers.
3. Draw a calling card, name the order and have students mark the order on their Bingo card.
4. Instruct those who mark three spaces in a row to shout "Bingo" and declare her/him the winner of the round.
5. Challenge: Once the students are familiar with the eight common orders, the game can be played with the teacher saying the insect names listed on the calling card rather than the order name. The students must identify which order the insect belongs to before they can mark the space on their Bingo card.

Cards to cut apart for use with Insect Orders Bingo

Beautiful Wings Moths, Butterflies 	X-Cellent True Bugs Stink bugs, Water bugs, Milkweed bugs 
Water Wingers Dragonflies, Damselflies 	Fast Flyers Flies, Gnats, Mosquitoes 
Tent Backs Cicadas, Aphids, Leafhoppers 	Musical Insects Grasshoppers, Crickets, Katydids 
Pretty Lined Beetles Ground Beetles, Fireflies, Weevils 	Stinging Insects Bees, Wasps, Ants 

Pretty Lined Beetles 	Fast Flyers 	X-Cellent True Bugs 
Tent Backs 	Free Space	Stinging Insects 
Water Wingers 	Beautiful Wings 	Musical Insects 

Beautiful Wings 	X-Cellent True Bugs 	Musical Insects 
Water Wingers 	Free Space	Stinging Insects 
Tent Backs 	Pretty Lined Beetles 	Fast Flyers 

Pretty Lined Beetles 	X-Cellent True Bugs 	Fast Flyers 
Musical Insects 	Free Space	Stinging Insects 
Water Wingers 	Beautiful Wings 	Tent Backs 

Stinging Insects 	Fast Flyers 	X-Cellent True Bugs 
Beautiful Wings 	Free Space	Pretty Lined Beetles 
Water Wingers 	Tent Backs 	Musical Insects 

Pretty Lined Beetles 	Water Wingers 	Tent Backs 
X-Cellent True Bugs 	Free Space	Stinging Insects 
Fast Flyers 	Beautiful Wings 	Musical Insects 

(To be used with Science Exploration 2-3)
Activity 2

Trading Cards

Materials

- Empty pint-sized milk cartons or JELL-O boxes (Prepare in advance by washing and cutting the top off.)
- Strips of construction paper cut to cover boxes
- Crayons or markers
- Copy of trading cards for each student

Activity

1. Distribute strips of construction paper and instruct students to print “My Insect Trading Cards” onto their strip. Allow time for students to decorate strips.
2. Have students staple or glue construction paper strips around the small box.
3. Distribute the trading cards for students to cut apart. Pictures should be left attached to the information card.
4. Read through the information on the cards and allow students time to color the insects.
5. Have students fold insect cards in half and store in the small box for future reference.

Optional Activity

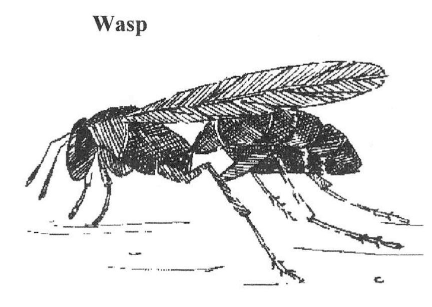
Cards may be cut completely apart and used in a slightly more difficult version of memory. Students will not be matching two pictures together. Instead, they will be matching the name of an insect order with the picture of a representative from that order. The picture cards are labeled with the name of the insect pictured and the order cards have example members listed, with the name of one example bolded. The bolded name on the order card is the same name as labeled on the picture card.

Learning Center Activity

In advance, prepare nine boxes such as those listed under materials—one box for each of the eight common orders of insects plus one extra box labeled “non-insects.” The “Insect Orders” cards could be cut apart and attached to each box as a label. In the center, provide the students with the eight boxes and a set of arthropod picture cards that have been cut apart. The students come to the center to sort the picture cards into the eight boxes according to which order the insects belong. Those pictures that show non-insects are placed into the box labeled “non-insects.”

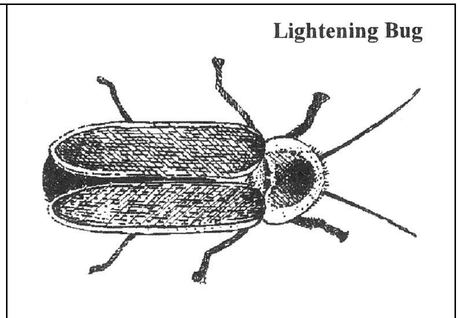
Stinging Insects
- Narrow waists
- Stinger at end of body
- Four clear wings

Examples
Bees, Ants, **Wasps**



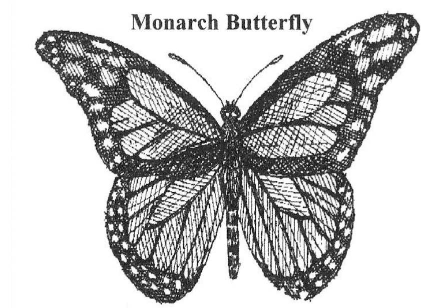
Pretty Lined Beetles
- Straight line down back
- Hard front wing covers

Examples
June Beetles, Asian Lady Beetles, **Lightning Bugs**



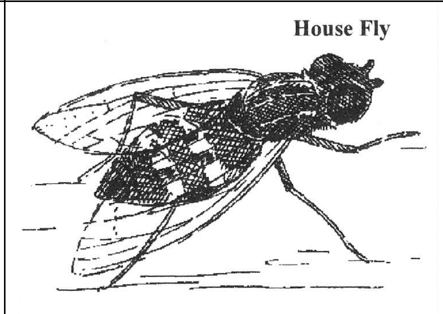
Beautiful Wings
- Four scale-covered wings
- Large compound eyes

Examples
Moths, **Butterflies**



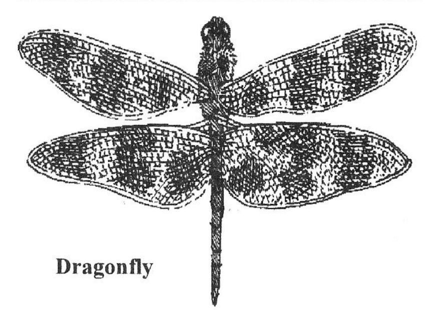
Fast Flyers
- One pair of developed wings
- Two large compound eyes

Examples
Mosquitoes, Gnats, **House Flies**



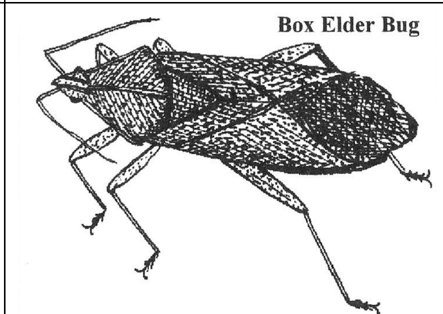
Water Wingers
- Narrow body
- Four long wings with many veins
- Very large compound eyes

Examples
Damselflies, **Dragonflies**



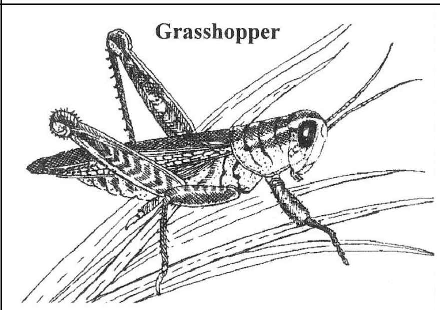
X-Cellent True Bugs
- X on back
- Only half of front wing hardened

Examples
Stink Bugs, Shield Bugs, **Box Elder Bugs**



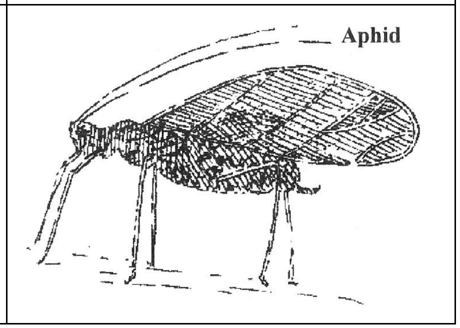
Musical Insects
- Large bent legs
- Thickened front wings when present

Examples
Crickets, Katydids, **Grasshoppers**



Tent Backs
- When folded across back, wings tent-shaped
- Beak attached to back of head

Examples
Leafhoppers, Treehoppers, **Aphids**

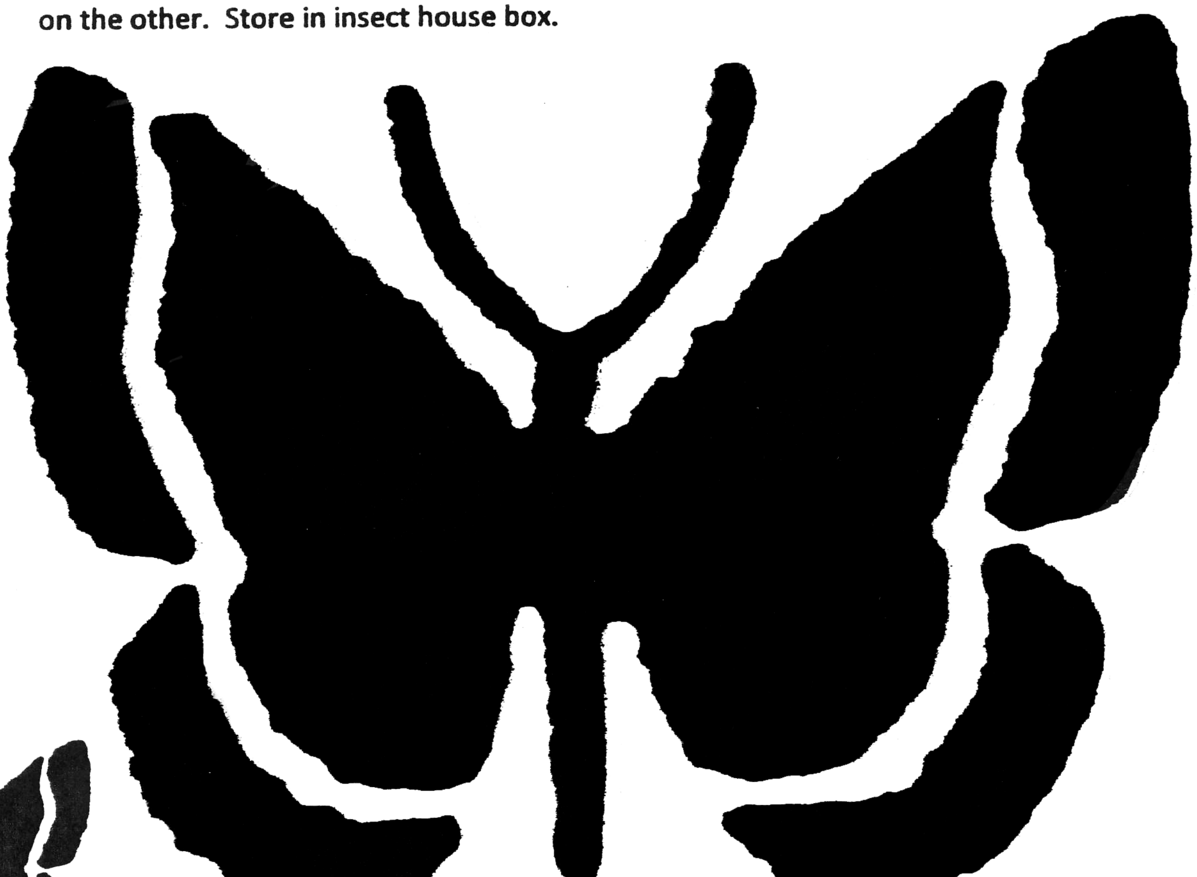


Insect House for Collector Cards

This
Insect House
Belongs to

____

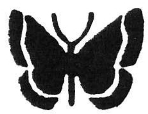
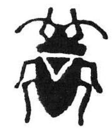
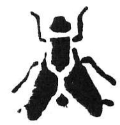
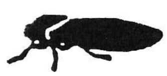
1. Reproduce patterns on paper. Cut out patterns along heavy lines.
2. Cut one end off a small JELL-O box or the top off of a small milk carton. Write your name on the label. Wrap the label around the front of the box and glue it in place.
3. Glue butterfly to back of wrapped box.
4. Cut out insect collector cards. Fold each card in half with words on one side and picture on the other. Store in insect house box.



Insect Orders Assessment

Entomologist____________________

Cut apart the pictures at the bottom and glue them in the correct box.

Beautiful Wings 	**X-Cellent True Bugs** 
Water Wingers 	**Fast Flyers** 
Tent Backs 	**Musical Insects** 
Pretty Lined Beetles 	**Stinging Insects** 

****

Insect Orders Assessment

Entomologist____________________

Cut apart the pictures at the bottom and glue them in the correct box.

Beautiful Wings	**X-Cellent True Bugs**
Water Wingers	**Fast Flyers**
Tent Backs	**Musical Insects**
Pretty Lined Beetles	**Stinging Insects**

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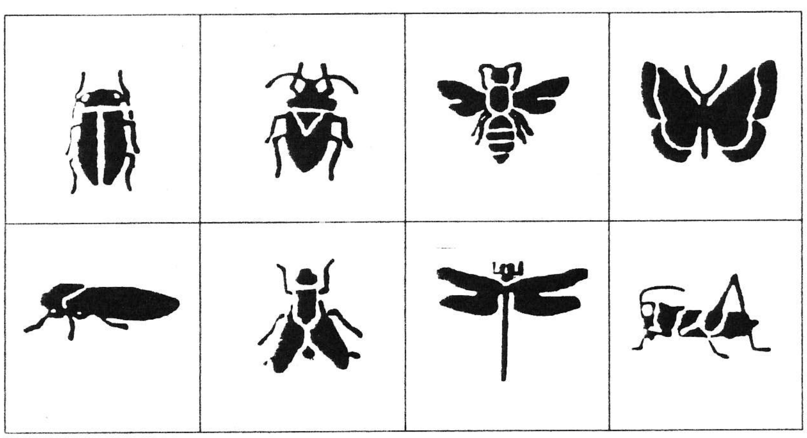


Science Exploration 3-1

Insect Metamorphosis

Essential Knowledge
- Entomologists are scientists who study insects.
- Throughout their life cycles, the structures of animals, including insects, change and may look very different from one stage to another.

Skills
1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.

Learner Outcomes
Students will be able to:
- Describe characteristics of metamorphosis.
- Describe different types of life cycles.
- Record observations in journals.

Materials
- Insect Development sheet
- Life cycle models/posters
- Science journals
- Entomologist model
- Book, *Insect Metamorphosis: From Egg to Adult*, by Ron and Nancy Goor
- Sorting Guide for Insects: Complete and Incomplete Metamorphosis
- Activity 1, Part 1: Simple Metamorphosis
- Activity 1, Part 2: Incomplete Metamorphosis
- Activity 1, Part 3: Complete Metamorphosis
- Activity 2: My, Oh My—a Butterfly! with flip book
- Activity 3: Growing and Changing with Teacher Narrative
- Look at Me! - assessment

Background
All living things experience a life cycle, a repeating process of egg, growth and reproduction. Like a mery-go-round or bicycle wheel, a cycle goes around and around without a beginning or an end.There are three different types of life cycles that animals may experience. Many animals including fish, mammals, reptiles, birds and silverfish (less than 1% of insects) have very *simple life cycles.*

Amphibians and about 10% of insects including dragonflies, damselflies, milkweed bugs, water bugs, cicadas, aphids, praying mantises, grasshoppers and katydids go through a slightly more complicated life cycle called *incomplete metamorphosis*. Other animals including most insects undergo a *complete metamorphosis* going through amazing changes to become adults. About 90% of insects go through a *complete metamorphosis* and include: beetles, flies, mosquitoes, bees, wasps, ants, butterflies and moths.

Simple Metamorphosis	**Incomplete Metamorphosis**	**Complete Metamorphosis**
Three stages: Egg - Young - Adult	Three stages: Egg - Nymph - Adult	Four stages: Egg - Larva - Pupa - Adult
Young very similar in appearance to adult except smaller	Young usually similar in appearance to adult but lacks wings	Very different in appearance from adult
Grow like humans	Nymph molts (sheds skin) several times as it grows. Some nymphs live in water.	Larva molts (sheds skin) several times before changing into pupa.
Feeds throughout its life	Feeds voraciously as a nymph	Feeds voraciously as a larva
No inactive stage	No inactive stage	Inactive with no feeding in pupa stage
Breeding stage	Breeding stage	Breeding stage

Class Time

Engaging the Students

- Remind students that they are apprentice entomologists. Today they are going to study insect life cycles.
- Hand out insect life cycle models, pictures and/or posters (Insect Development sheet) to working groups.
- Facilitate a discussion of life cycles, the different types of life cycles and the different stages of each life cycle, including the human life cycle.

Investigation

Students will:

- Observe the models, pictures or posters for characteristics, such as patterns, colors, shapes, number of legs, number of eyes, etc. in each life cycle stage.
- Sort insects into the different life cycle stages: egg, larva or nymph, pupa, and adult.
- Record observations of each stage of development for each insect observed. (The teacher may want to show them how to use a simple table or lists to organize their observations.)

Sharing and Summarizing

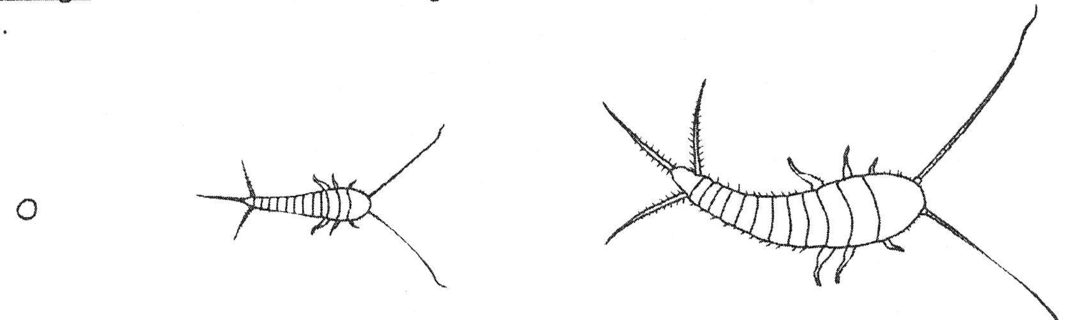
- Have students share observations with the class.
- Read book, *Insect Metamorphosis: From Egg to Adult*
- Revisit the roles of an entomologist and record any new ideas on the model.
- Activity 1, Parts 1, 2, and 3: Simple Metamorphosis, Incomplete Metamorphosis, Complete Metamorphosis
- Hang posters: Sorting Guide for Insects: Complete and Incomplete Metamorphosis and/or Insect Development.
- Activity 2: My, Oh My—a Butterfly! with flip book

- Activity 3: Growing and Changing with Teacher Narrative
- Look at Me! Assessment

Insect Development

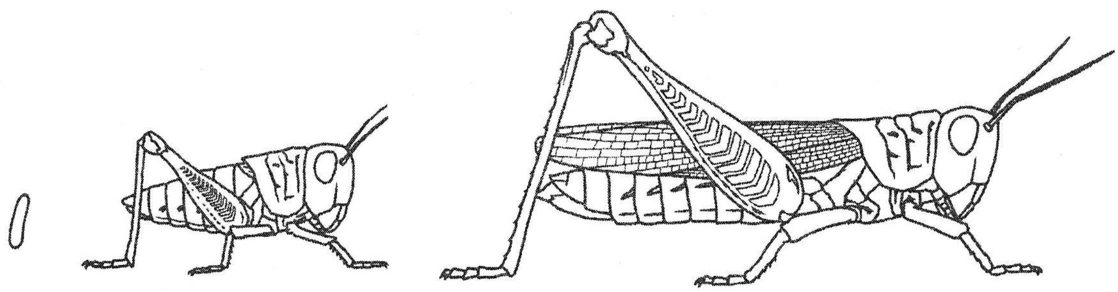
Metamorphosis is the change in shape and habits of an insect as it grows into an adult. Insects develop from an egg to an adult in three ways.

Simple Change - The insect's size changes as it matures. For example, this is how a silverfish develops.



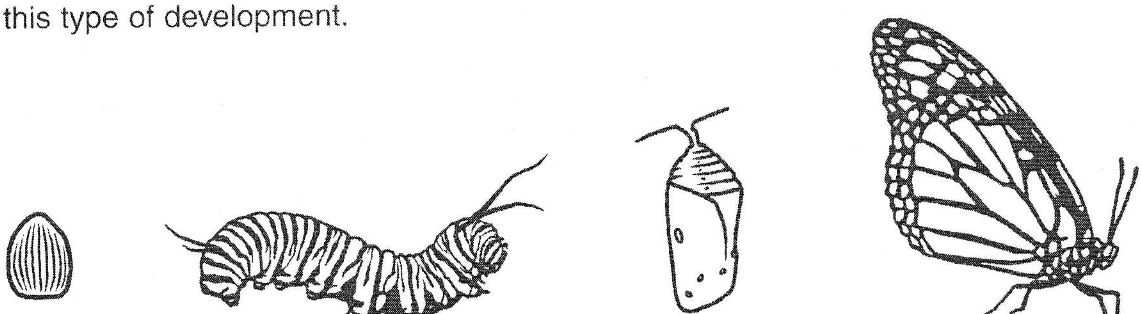
egg young adult

Incomplete Change – The nymph looks like a small adult, but it has no wings and cannot reproduce. A grasshopper develops this way.



egg nymph adult

Complete Change – The insect must go through two stages between egg and adult. A butterfly has this type of development.



egg larva pupa adult

Insects often move, breathe and eat differently in each stage of development, helping them to survive changes in food supply, temperature or other harsh conditions.

(Tool to be used with Science Exploration 3-1 and 3-2)
Kinesthetic – Activity 1, Part 1

The Simple Life Cycle

Materials

- One small paper plate per child
- One small paper plate with one-third cut out (prior to lesson) per child
- One brad per child
- Scissors and crayons or colored pencils
- Human Life Cycle Cards per child

Activity

1. Ask students what they know about the words "life cycle." Discuss that life cycles are the different stages that a living thing, such as an animal, goes through in its lifetime, including birth, growth, and adulthood.
2. Explain that "reproduce" means to produce offspring (babies) of the same species. Most animals, including fish, mammals (including humans), reptiles, birds and silverfish, which make up less than 1% of insects, have very *simple life cycles,* consisting of three stages—birth (either live or hatched from eggs), young and adult. The young are similar to their parents, just smaller. These animals slowly become adults.
3. Inform students that today they will make up a life cycle card showing a simple life cycle.
4. First, show students the three Human Life Cycle cards. Ask one student to come to the front of the room to demonstrate the behavior of one of the cards. The other students must guess which life cycle card the student is acting out. Repeat with other cards until all cards have been revealed and students understand the difference in the stages.
5. Demonstrate how to make a life cycle wheel. First, have students put the life cycle cards in the proper order around the outside of the whole paper plate, then glue them. Label each life cycle stage. Have students cut out the words "simple life cycle" and glue them to the outside of the paper plate with one-third cut out. Once the glue is dry, show students how to use a brad to connect two paper plates together. Have them connect the plates placing the paper plate with one-third cut out on top. Demonstrate how this top plate turns to reveal one stage of the life cycle at a time. Put student's name on the back.
6. Review the simple life cycle together.

Simple Life Cycle of a Human

		
baby	**young**	**adult**

(Tool to be used with Science Explorations 3-1 and 3-2)
Kinesthetic - Activity 1, Part 2

The Incomplete Life Cycle of an Insect

Materials

- One small paper plate per child
- One small paper plate with one-third cut out (prior to lesson) per child
- One brad per child
- Scissors and crayons or colored pencils
- Incomplete Insect Life Cycle Cards per child
- Book, *Insect Metamorphosis: From Egg to Adult,* by Ron and Nancy Goor

Activity

1. Review the definition of a life cycle with students. In Part 1 they learned about the *simple life cycle*.
2. Tell students that the word *metamorphosis* means change. Teach students that some animals have a slightly more complicated life cycle, called *incomplete life cycle.* Animals with an incomplete life cycle are born (either live or hatched from eggs), spend their nymph stage eating and molting several times, and grow into adults. This group includes about 10% of insects such as dragonflies, damselflies, milkweed bugs, water bugs, cicadas, aphids, praying mantises, grasshoppers, and katydids. As nymphs, many of these insects look like adults but without wings.
3. Read the book, *Insect Metamorphosis: From Egg to Adult,* pages 19-25. Discuss how the changes of an incomplete life cycle differ from the changes of a simple life cycle.
4. Demonstrate how to make an *incomplete life cycle* wheel for the dragonfly with students. Make sure that students attach the Incomplete Insect Life Cycle of a Dragonfly Cards in the proper order around the whole paper plate and label them eggs, nymph, and adult. Glue the name "Incomplete Life Cycle of a Dragonfly" onto the outside edge of the plate with the one-third cut out. Using the brad, connect the paper plate with 1/3 cut out to the whole paper plate. The plate with the one-third cut out should be on top. Demonstrate how this top plate turns to reveal one stage of the life cycle at a time.
5. Put student's name on the back and compare to the Simple Life Cycle Wheel.

Incomplete Life Cycle of a Dragonfly

 eggs	nymph 	 adult

(Tool to be used with Science Exploration 3-1 and 3-2)
Kinesthetic Activity 1 part 3

The Complete Life Cycle of an Insect

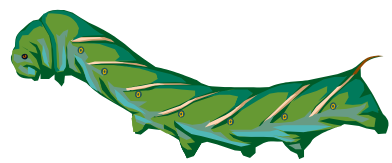
Materials

- One small paper plate per child
- One small paper plate with one-fourth cut out (prior to lesson) per child
- One brad per child
- Scissors and crayons or colored pencils
- Complete Life Cycle of a Butterfly sheet per child
- Book, *Insect Metamorphosis: From Egg to Adult*
- Songs: *Butterfly, Butterfly,* by Jan Warren; *The Caterpillar Song,* anonymous; *Look! I'm a Butterfly,* anonymous

Activity

1. Review the definitions of life cycle and metamorphosis with students, reminding them that in Part 1 they learned about the *simple life cycle* and in Part 2, the *incomplete life cycle*. Tell students that they will learn about a really big change in the metamorphosis of an insect, the *complete life cycle.*
2. Remind students that most insects (90%) undergo a *complete metamorphosis* in their life cycles. These insects have four stages in their life cycle—egg (unborn stage), larva (young stage when most feeding is done—they may look like worms), pupa (inactive with no feeding), and adult (final breeding stage). Insects that go through a complete metamorphosis include: beetles, flies, mosquitoes, bees, wasps, ants, butterflies and moths. These insects do not look like their parents when born.
3. Read the book, *Insect Metamorphosis: From Egg to Adult*, pages 1–18. Point out that in the simple and incomplete life cycles there are only three stages and that the young look somewhat like the adult in form. But in the *complete metamorphosis,* there are four stages and many changes occur throughout the life of the insect.
4. Make one final life cycle wheel; this time of the butterfly. Point out that the outer plate has been cut in fourths to allow four cycles to be shown in the life cycle. Demonstrate and make together the life cycle wheel following procedures mentioned in Parts 1 and 2.
5. Have students compare the three life cycle wheels.
6. Sing the songs *Butterfly, Butterfly, The Caterpillar Song,* and/or *Look! I'm a Butterfly.*

Complete Life Cycle of a Butterfly

 eggs	 larva
 pupa	 adult

Butterfly, Butterfly

By Jan Warren

Butterfly, butterfly, laying lots of eggs.

The eggs hatch caterpillars with short, stubby legs.

Caterpillar, caterpillar, eating 'til you're big.

Then walking very slowly . . . you hang from a twig.

Sleep now, and change, but very, very soon . . .

Caterpillar, caterpillar, you changed, you didn't die.

You grew wings, and long legs, to become a

beautiful butterfly!

Caterpillar Song

(Tune: Yankee Doodle)

I started as a tiny egg
Upon a leaf of green.
And now I stay upon the leaf
So I will not be seen.

Soon I'll build a chrysalis
Upon a limb up high.
I'll stay awhile and then come out
And be a butterfly!

Look! I'm a Butterfly!

Sing Along

(Sung to the tune of "Pop Goes the Weasel")

I spin and spin my chrysalis,

(Circle fingers on palm.)

Then go to rest inside.

(Close fingers and rest hand on palm.)

When I come out,
I've changed indeed. . . .

(Open fingers slowly.)

Look! I'm a butterfly!

(Fly fingers away.)

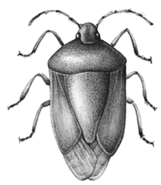
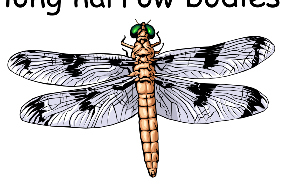
Sorting Guide for Insects

Complete Metamorphosis

Orders	Common Name	Characteristics	Examples
COLEOPTERA straight lines on back 	PRETTY LINED BEETLES	hard front wing covers membranous back wings for flight chewing mouthparts	beetles fireflies weevils
DIPTERA one pair of wings 	FAST FLYERS	one pair of wings two large compound eyes piercing and sucking mouthparts	flies mosquitoes gnats
HYMENOPTERA narrow waists 	STINGING INSECTS	four clear wings, if present slender waist, stinger at end of body chewing or sucking mouthparts	bees wasps ants
LEPIDOPTERA four scale-covered wings 	BEAUTIFUL WINGS	four wings covered with overlapping scales large compound eyes sucking mouthparts	butterflies moths

Sorting Guide for Insects

Incomplete Metamorphosis

Order	Common Name	Characteristics	Examples
HEMIPTERA "x" on back 	X-CELLENT TRUE BUGS	portion of front wings leathery "beak" attached to front of head piercing and sucking mouth parts	stink bugs milkweed bugs water bugs
HOMOPTERA tent-shaped backs 	TENT BACKS	wings, if present, fold over back "beak" attached to front of head piercing and sucking mouth parts	cicadas leafhoppers aphids
ODONATA long narrow bodies 	WATER WINGERS	four elongated, many-veined wings very large compound eyes chewing mouth parts	dragonflies damselflies
ORTHOPTERA large bent hind legs 	MUSICAL INSECTS	thickened front wings, when present long antennae and legs chewing mouth parts with large jaws	grasshoppers crickets katydids

(To be used with Science Exploration 3-1)
Language Arts - Activity 2

My, Oh My—a Butterfly!

Materials

- *My, Oh My—a Butterfly!* by Tish Rabe
- A Butterfly's Life flip book (made prior to class for each child)
- Stapler or binding spine, crayons, pencils

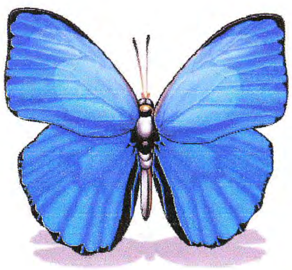
Activity

1. Read the book, *My, Oh My—a Butterfly!*
2. Review the stages of complete metamorphosis.
3. Fill out the flip book, either as a group when reading, or during observations of live butterflies.
4. Share with peers.

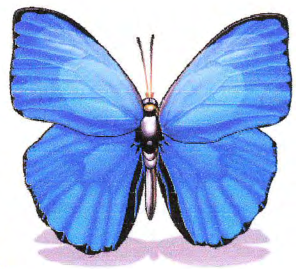
Staple or bind here

Staple or bind here

A Butterfly's Life



Flip Book



Entomologist ______________________________

egg

larva

pupa

adult

Cut each page to size, binding or stapling at top. Each page can contain a line and illustration about that stage in the complete metamorphosis.

egg

larva

pupa

adult

(To be used with Science Exploration 3-1)
Language Arts – Activity 3

Growing and Changing
Going through a Butterfly Life Cycle

Materials

- Book, *The Life Cycle of a Butterfly*
- Teacher narrative
- Space on the floor to "grow" into a butterfly
- Soft music to "grow" with (optional)

Activity

1. Read the book, *The Life Cycle of a Butterfly.*
2. Have students "become" a butterfly by listening to directions in the teacher narrative.
3. Discuss student feelings.

(To be used with Science Exploration 3-1, Activity 3)
Language Arts – Activity 3

Growing and Changing
Teacher Narrative

You are a tiny caterpillar inside a round egg lying on a leaf.
Following your instincts you slowly begin to break out of your egg case.
Slowly, one part at a time, stretch your new long caterpillar body out onto the ground.
You are very hungry, and begin to crawl around and search for yummy leaves to eat.
Finding some delicious, juicy green leaves you eat and eat and eat.
Your body begins to stretch and grow bigger and longer, bigger and longer.
The more you eat the more you grow, until suddenly . . .

(TURN OFF THE LIGHTS.)
You stop!

(TEACHER PAUSES.)
Curl up on your side and start to spin a strong, protective chrysalis around your body.
Spin with silk thread from your mouth.
Spin from your toes up and around, up and around, up and around until you reach the top of your head!
Close yourself in.
Lie very still inside the chrysalis.
Your body is changing.
Wiggle slowly inside your chrysalis as you grow wings and muscles with which to fly.
Wiggle and rest, wiggle and rest, wiggle and rest.
Now you are ready!
Slowly break out of the chrysalis.
Slowly stretch out your wings.
Slowly stretch out your body.
Slowly stretch out your legs.
Very slowly move and stretch your new wings up and down, up and down, up and down.
Little by little begin to fly around the room.
When it is light in the room you love to fly, but in the dark you rest and stay still.

(TURN OFF THE LIGHTS.)
Rest and lay still, rest and lay still, rest and lay still.

(TURN ON THE LIGHTS.)
It is light again, fly around and flap your wings.
Gently fly, gently fly, gently fly.

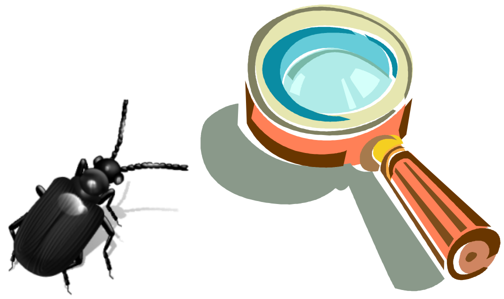
(TURN OFF THE LIGHTS.)
It is night again. Rest and lay still, rest and lay still, rest and lay still.

(TURN ON THE LIGHTS.)
Gently fly, gently fly, gently fly.

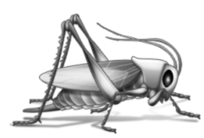
(TURN OFF THE LIGHTS.)
Rest and lay still, rest and lay still, rest and lay still.

Entomologist___________________________

Look at Me!



Take a good look at the insects on this worksheet. Using your Sorting Guide for Insects, decide which insects have complete metamorphosis and which have incomplete metamorphosis. Circle your choice. Be careful.

 **Complete Metamorphosis** **Incomplete Metamorphosis**	 **Complete Metamorphosis** **Incomplete Metamorphosis**
 **Complete Metamorphosis** **Incomplete Metamorphosis**	 **Complete Metamorphosis** **Incomplete Metamorphosis**

Science Exploration 3-2

Metamorphosis Live!

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects are divided into groups according to similarities and differences.
- Throughout their life cycles, animals, including insects, change and may look very different from one stage to another.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists make accurate drawings with details about the subject.
   c. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Describe characteristics of metamorphosis.
- Identify different types of metamorphosis.
- Record observations in journals.

Materials

- Live specimens of milkweed bugs with food and habitat
- Live specimens of butterflies or mealworms with food and habitat
- Magnifying lenses
- Science journals
- Tools made in Activities 3-1-1, 3-1-2, 3-1-3
- Entomologist model
- *Mealworm Poem*, Anonymous

Background

Exploration 3-1 introduced students to the three types of metamorphosis. They are familiar with simple metamorphosis since that is how the changes in their own bodies occur. By observing milkweed bugs and either butterflies or mealworms, they will be able to observe incomplete and complete metamorphosis.

The milkweed bug may be purchased as egg, nymph or adult. The milkweed bug goes through incomplete metamorphosis. Like in simple metamorphosis, the egg may not be visible to the naked eye. However, when cared for properly, the second stage will be visible as the tiny milkweed bugs hatch. Once they hatch, students will be able to observe the tiny bugs (nymphs) and study their characteristics. Note that these nymphs have no wings. Over a number of days, the nymphs will molt several times allowing them to grow and will sprout wings. The adults will look very similar to the nymphs, except with wings.

You usually purchase butterflies as caterpillars. If you use butterflies, the students will be able to observe complete metamorphosis. Most butterfly eggs are visible to the naked eye. When cared for properly, these eggs hatch into caterpillars. The students will observe the caterpillars as they eat and molt. After a time, the caterpillars should each spin a chrysalis, the pupa stage. Inside the chrysalis an amazing transformation is taking place. The students may observe some changes in the chrysalis itself, but it isn't until the butterfly emerges that they will observe the transformation.

You can use mealworms instead of butterflies to allow students to observe complete metamorphosis. Mealworms are actually the larval stage of a *Tenebrio* (darkling) beetle. Usually purchased as adults, these beetles will lay hundreds of eggs to start your study. As with the milkweed bugs, the egg stage of the beetle will not be visible to the naked eye. As the eggs mature, they will hatch into tiny mealworms that are easily observed. As these mealworms eat and grow, the students observe them molting and eventually going into their pupa stage, which appears as an immobile shell, shorter and wider than the larval stage. After spending time in the pupa stage, the beetle will emerge. The beetle is tan when it first emerges, soon changing to brown and finally the characteristic black of this species.

It is important that the students observe their specimens daily because the times required for change will vary. By using live specimens, the students learn another skill necessary for an entomologist and get to observe firsthand one of the mysteries of nature.

Class Time

Note: Other activities in this manual may be used while waiting for the live specimens to undergo change.

Engaging the Students

- Hand out milkweed bugs and butterfly larva or mealworms to each student.
- Discuss with students the importance of handling live specimens carefully and explain how to care for them.

Investigation

Students will:

- Observe their insects carefully, using a magnifying lens to see more details.
- Record observations in journals.

Sharing and Summarizing

- Have students share what they have learned with the class and post results.
- Facilitate a discussion of the stage and/or stages of metamorphosis the students observed.
- As further changes take place, discuss the types of metamorphosis of the different specimens, using the tools made in Activity 3-1-1, 3-1-2, and 3-1-3.
- Revisit the roles of an entomologist and record any new ideas on the model.
- Teach *Mealworm Poem* if using mealworms in the exploration.

(To be used with Science Exploration 3-2)

Working with Live Insects

There are many advantages to working with live insects for young children. Not only do they get to experience the changes of metamorphosis firsthand, they are able to get a close look at the insect, learning about its morphology and possibly overcoming a fear of insects. They also learn of the needs of living organisms and how to care for them.

There are a number of choices when looking to provide insects for the classroom. Insects may be purchased through science supply houses. Their food and habitat may also be purchased through supply houses, or in some cases, bought at the grocery store or constructed of easily obtainable materials. When choosing insects, if possible, choose an insect that undergoes incomplete metamorphosis and an insect that undergoes complete metamorphosis so that the students are able to compare the different life cycles.

Milkweed bugs are often the insect chosen to study incomplete metamorphosis. The milkweed eggs are purchased from a science supply house and will soon hatch into tiny nymphs. The nymph milkweed bugs may be fed shelled, unsalted sunflower seeds and kept in simple homemade habitats. As the nymphs mature into adults, a milkweed plant should be provided. The adult milkweed bugs will lay their eggs on the milkweed.

A simple habitat for the milkweed bug is a gallon-size baggie. Air holes are made in the top of the baggie using a push pin. A sturdy V-shaped stick is placed in the baggie. The V-shaped stick has a cotton ball stretched across the V and sunflower seeds wrapped in netting and attached with a rubber band to the stick providing food. Take a small vial of water and punch two holes in the top. One hole will hold a wick made from twisted paper towel and the other a short piece of thin plastic tubing. A hole just large enough to hold the vial and another just large enough for the tubing to stick through should be made in the bottom of the baggie. (The tubing will be used to add water when needed. The water can be inserted into the tubing using a small syringe.)

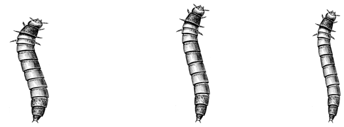
Another insect that may be purchased that undergoes incomplete metamorphosis is the **praying mantis.** Egg sacks of the praying mantis are purchased from the supply house. The sac may be placed in a habitat made of fine mesh wire stuck into a clay base. The mesh must be small enough so that the tiny nymphs do not escape after they emerge from the sac. A source of moisture and food (wingless fruit flies) must be placed in the habitat, as hungry praying mantis nymphs may cannibalize the other nymphs if a supply of food isn't readily available.

When choosing an insect that undergoes complete metamorphosis, there are a number of choices. The **darkling beetle,** whose larval stage is the **mealworm**, is perhaps the easiest to care for.

Mealworms or adult beetles arriving from the supply house may be transferred into a plastic tub filled with oat bran, oatmeal or cornmeal. A damp paper towel or small piece of apple, carrot or sweet potato should be added for moisture. (If apple, carrot or potato is used, make sure it is replaced often so that it doesn't become moldy). Place a loose cover over the tub so that the beetles can't escape but can get air. (If the top fits tightly, use a pushpin to make air holes in the top.) Moisture should be added every 3 to 4 days. Fresh food should be added periodically. The adult beetles, pupa and larva need to be transferred to new medium every three or four months, as waste, shed skins and dead beetles will accumulate. Mealworms may be placed in small plastic vials or Petri dishes for individual students to observe.

Butterflies are possibly the most exciting insects to raise. The transformation from caterpillar to butterfly is amazing and most students enjoy the beautiful butterfly. Butterflies are purchased as caterpillars and arrive in a cup with food for the larva. The caterpillars may remain in this cup until they form their chrysalis. The chrysalis is then moved to a butterfly house, either laid on a piece of paper folded like an accordion or hung on the screen. Moisture should be added to the house. When the adult emerges, it may be fed a solution of 10% sugar water. To breed the butterflies, their host plant must be made available. Butterflies will lay their eggs on the host plant and the caterpillars feed on this plant before forming a chrysalis. (The Monarch's host plant is milkweed. The Painted Lady's host plant is mallow.) Butterfly houses may be purchased from supply houses. Larger screened houses are better for student observation, although smaller, less expensive plastic houses are available. Both can be used over and over again. A homemade screen house may be constructed.

Mealworm Poem



My mealworm likes to crawl around
And eat up all its flakes.
It may not look so cute just yet,
But wait to see what nature makes!

Right now it's in its larval stage.
It wiggles and it's small.
And soon it's very, very still.
It does not move at all.
This is called the pupa stage when it takes a rest.
Soon it changes how it looks.
It's a beetle at its best!

Science Exploration 4-1

Insect Jobs in Our World

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects are divided into groups according to similarities and differences.
- The five main jobs of insects are decomposing, pollinating, soil tilling, producing and controlling pests.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Describe some jobs performed by people.
- Describe the importance of animals in our world.
- Name the five main roles of insects.
- Describe the importance of insects in our environment.

Materials

- Items such as stethoscope, shovel, fire truck, police badge, hammer, weather map, map of stars, magnifying lenses, etc.
- Science journals
- Chart paper
- Sets of pictures of insects at work in nature
- “Insect tools” including a Q-tip (fuzzy body of a bee), small piece of pipe cleaner (jointed legs of an insect), plastic forceps (claws or jaws of an insect), and plastic pipette (mouthparts of an insect)
- Book, *Helpful And Harmful Insects*, by Aloian, Molly and Kalman
- Posters that describe the different jobs performed by insects
- Pages to create booklet describing the different jobs performed by insects
- Activity 1: Insects for Hire
- Activity 2: What Do You Do?
- Activity 3: Memory
- Activity 4: Go Fish
- Insect Job Description - assessment
- Insects at Work in Our World - assessment

Background
When we hear the word "insect," we often have negative thoughts—buzzing, stinging, biting, etc. Insects, however, play a very important role in the health of our environment. Some of the ways insects are useful include:

- Insects are valuable sources of food for birds, fish, toads, lizards, snakes and frogs, as well as many mammals.
- Insects produce useful things for us such as honey, beeswax and silk.
- Insects pollinate many food crops, flowers and plants.
- Insects are predators of pests that can destroy plants in our gardens and food crops.
- Many insects also play critical roles in recycling plant and animal materials, eliminating waste and keeping the soil healthy.

People's lives would be very different without the benefits provided by insects. It is highly unlikely that people would be able to survive on earth without insects.

Class Time

Exploration Part I

Engaging the Students
- Facilitate a discussion of careers the students would like to have when they are older (ask students who are unable to give an answer to share with the group a job their parent performs) and record the jobs on chart paper.
- Ask students to turn to a partner and discuss the importance of all the jobs listed—why we need people doing these different jobs.
- Divide students into small groups and give each group items such as stethoscope, shovel, fire truck, police badge, hammer, weather map, map of the stars, magnifying lens, etc.

Investigation
Students will:
- Examine the items, identify jobs in which these tools might be used and discuss how these jobs benefit us.
- Record in their journals tools that entomologists use.

Sharing and Summarizing
- Have each group share their findings and post them on different pieces of chart paper, grouping similar information together.

Exploration Part II

Engaging the Students
- Facilitate a discussion of the roles different animals play in our lives. Examples: We get food from chickens, pigs and cows. Dogs and cats give us pleasure. Horses can be used for traveling.
- Find out what students know and would like to find out about the jobs insects do that make our world a better place.

Investigation
Students will:
- Work in cooperative groups.

- Examine the sets of pictures of insects working in nature and record their observations of what they think the insects are doing in each picture along with an idea of how these insects are helping people.
- Explore a set of "insect tools" including a Q-tip (fuzzy body of bee), piece of pipe cleaner (jointed legs of an insect), plastic forceps (claws or jaws of an insect), and plastic pipette (mouthparts of an insect) that are used in doing their jobs.
- Record ideas about how insects use these "body parts."

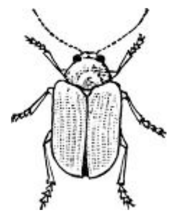
Sharing and Summarizing

- Have each group share what they have observed the insects doing in the different pictures and post their findings on five different pieces of chart paper grouping similar information together.
- Facilitate a discussion on how insects might use their "tools" and add their ideas to the appropriate chart paper.
- Read book, *Helpful and Harmful Insects*.
- Add new learning from the book to the charts as needed.
- Elicit the five different jobs insects perform (pollinate, produce, decompose, till soil, control pests) and label each chart of information with the correct heading.
- Hang posters and/or create booklet describing the different jobs insects perform.
- Activity 1: Insects for Hire
- Activity 2: What Do You Do?
- Activity 3: Memory
- Activity 4: Go Fish
- Activity 5: Bee Boogie
- Activity 6: Insects and Birds
- Insect Job Description - assessment
- Insects at Work in Our World - assessment

The Decomposers

These insects feed on and recycle the dead bodies of animals and decaying plants.

Fly



Beetle

Wasp

They help rid the world of decaying organic matter and replace it with nutrients that make the soil better for growing plants.

The Pollinators

These insects collect pollen on their bodies as they drink nectar from flowers. When the insects look for more nectar from other flowers, they fertilize the flower with the pollen on their bodies. This process helps to make more plants.

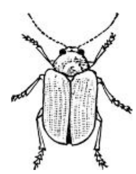
Bees

Butterflies

Moths

Flies

Wasps



Beetles

Species of bees, beetles, flies, wasps, butterflies and moths are all successful pollinators. They make good pollinators because they are drawn to plants and like the taste of the sweet nectar that plants produce. They also fly and are able to visit many plants in a short amount of time, transferring pollen from one plant to another.

The Population Controllers

These insects hunt, capture, and eat other insects.

Ladybug

Praying Mantis

Dragonfly

All of these insects are helpful to people, plants, and animals. They help reduce the number of pest insects that eat flowers and crops and keep insect populations under control.

The Producers

These insects produce or make something that is helpful to people.

Honeybees

Larva of the Silkworm Moth

Fly Maggot

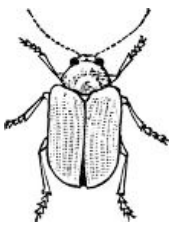
Honeybees give us honey to eat and beeswax that can be made into candles and other products.

The larva of the silkworm moth produces silk that can be made into cloth.

Fly maggots have been used to help clean and treat wounds.

The Soil Tillers

These insects help to get air and water into the soil that helps to make the soil better suited for growing plants.



Beetle

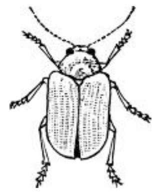
Ant

Wasp

Digger bees

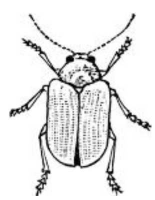
As these insects burrow, they turn over the soil, making holes that let air and water into the ground. Waste from these insects fertilizes the soil.

Insects at Work in Our World



Entomologist ________________

Insects at Work in Our World



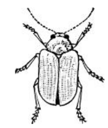
Entomologist __________________

The Decomposers

These insects feed on and recycle the dead bodies of animals and decaying plants.


Fly


Wasp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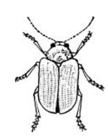
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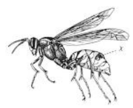
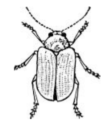
Bees


Butterflies


Moths


Flies


Wasps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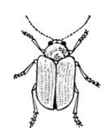
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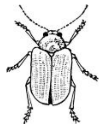

Beetle

Ant

Wasp

Digger Bee

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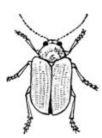

Beetle

Ant

Wasp

Digger Bee

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(To be used with Science Exploration 4-1)
Language Arts – Activity 1

Insects for Hire!

Materials

- Insect job charts from Exploration 4-1
- Collection of insect-produced goods
- Nonfiction insect books with clear pictures of insects
- Post-it® notes
- Tagboard, crayons and markers

Activity

1. Review insect job charts created in Lesson Part I.
2. Share with students the collection of insect-produced goods and allow time for exploration of and questions about products. (Why are these products important?)
3. Share with students that they are now detectives on the hunt for insects at work.
4. Provide students with a collection of non-fiction books about insects and have them work in cooperative groups to find pictures of working insects. Mark the pages with a Post-it® note.
5. Have students choose one of the insects they find to create a "Help Wanted" poster advertising the job that the insect in their picture is performing. Posters will include a picture of the insect and a short description of the "work" being done in the picture.

(To be used with Science Exploration 4-1)
Language Arts – Activity 2

What Do You Do?

Materials
- Character cards: 3-4 copies of each card depending on the number of students in the class
- Individual copies of *What Do You Do?* chant or a copy of the chant printed on chart paper

Activity
1. Explain to students that they will be divided into six different groups. Some will remain as students and some will play the role of an insect.
2. Label the groups: the class, the pollinators, the decomposers, the soil tillers, the producers and the population controllers.
3. Have students assigned to be insects hold the appropriate character card up to identify which insect group they are portraying.
4. Have students perform the chant with each group reading their assigned part.
5. Ask students to switch parts and repeat the chant until all students have had the chance to be a member of each of the five different groups.

What Do You Do?

Class: Pollinators, pollinators, what do you do?

The Pollinators: We move pollen for the plants and you.

Class: Decomposers, decomposers, what do you do?

The Decomposers: We break down dead matter for the plants and you.

Class: Soil tillers, soil tillers, what do you do?

The Soil Tillers: We aerate the soil for the plants and you.

Class: Producers, producers, what do you do?

The Producers: We make useful things for other animals and you.

Class: Population controllers, population controllers, what do you do?

The Population Controllers: We limit the number of insects
for the plants and you.

Class: Insects, insects, what do you do?

All Insects: We make the world a better place for you.

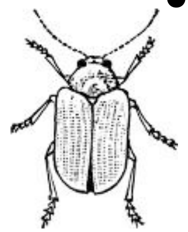
Population

Controller

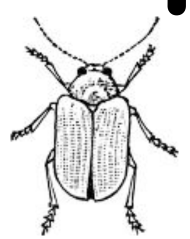
Population

Controller

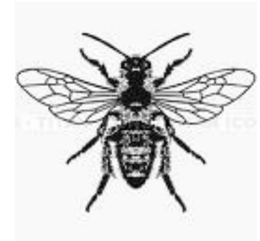
Decomposer



Decomposer

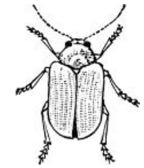


Producer

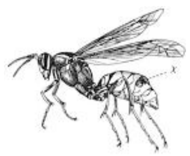


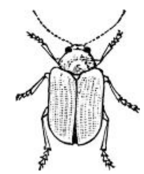
Producer



Pollinator

Pollinator


Soil Tiller

Soil Tiller

(To be used with Science Exploration 4-1)
Activity 3

Memory

Materials
- Two copies of memory cards
- Scissors
- Ziploc® bags

Activity
1. Explain to students that they will be working with a partner to play a memory game that will help them be able to identify insects that are producers, pollinators, soil tillers, population controllers and/or decomposers.

2. Have partners work together to cut apart the picture cards on their two pages of memory cards and then turn the picture cards upside down on a flat surface.

3. Instruct students to take turns turning over two cards, trying to find a match.

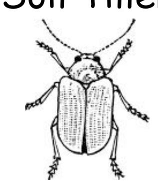
4. Tell the players that as they turn the cards over, they must say the name of the insect and a group to which it belongs. For example, “A wasp is a pollinator.”

5. Let the player know if he/she is successful at finding two matching pictures, he/she gets to keep the pictures and take another turn.

6. When all pictures have been matched, declare the student with the most cards the winner of the game.

7. Have students store the cards in the Ziploc® bags for future use.

Memory Cards

Praying Mantis – Population Controller 	Butterfly - Pollinator 	Moth - Pollinator 
Ladybug – Population Controller 	Ant – Soil Tiller 	Wasp – Pollinator/Decomposer/ Soil Tiller 
Bee – Producer/Pollinator/ Soil Tiller 	Fly – Pollinator/Decomposer 	Beetles – Pollinator/Decomposer/ Soil Tiller 
Dragonfly – Population Controller 	Fly Maggot – Producer/Decomposer 	Silkworm - Producer 

(To be used with Science Exploration 4-1)
Activity 4

Go Fish

Materials

- Decks of *Go Fish* cards (prepared by teacher in advance)

Activity

1. In advance, prepare four or five decks of *Go Fish* cards depending upon the number of students in the class. Three or four students may play per deck. Each deck should contain six of each of the following cards: pollinators, producers, decomposers, soil tillers and population controllers. Decks can be laminated and stored in Ziploc® bags for future use.

2. Divide students into small groups and explain *Go Fish* rules.
   a. Deal four cards to each player; put the rest of the cards in the center, face down.
   b. The first player asks any other player for a card that matches one of his or her own (e.g., “Joe, do you have any producers?).
   c. If Joe has a producer card, he must hand it over. If he does not, he responds, “Go fish.” The first player then draws one card from the deck.
   d. Play advances to the next player to the left.
   e. Whenever a player gets a pair that matches, the cards are laid down, face up.
   f. When no more matches can be made, the winner is the player with the most matches.

Go Fish

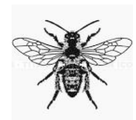
Producers



Producers



Producers



Producers



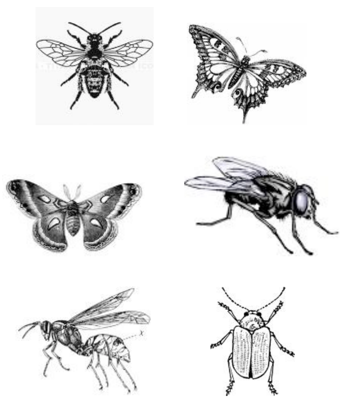
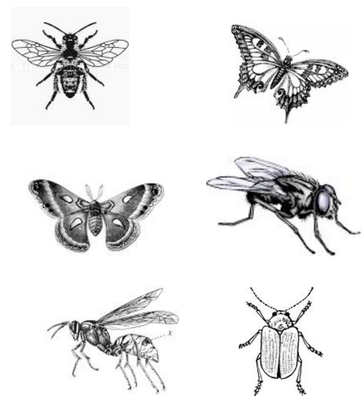
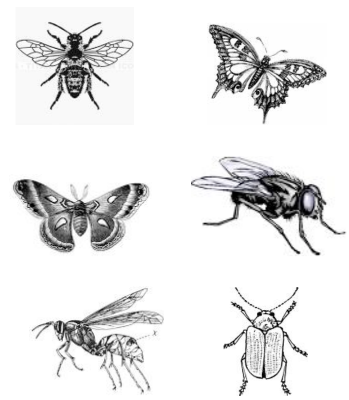
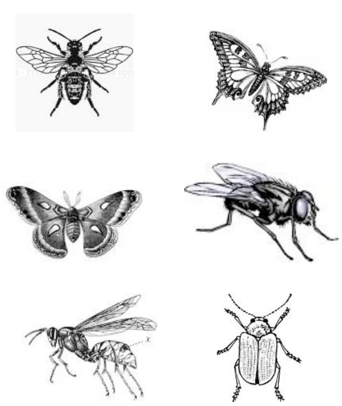
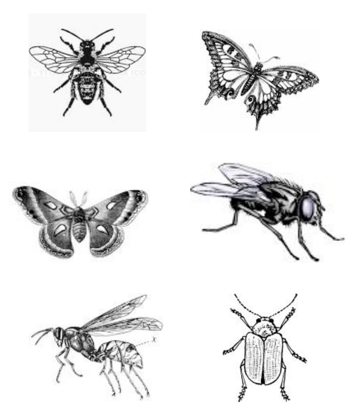
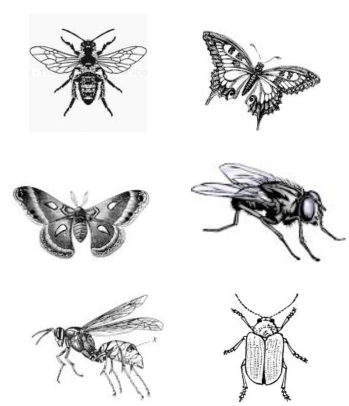
Producers



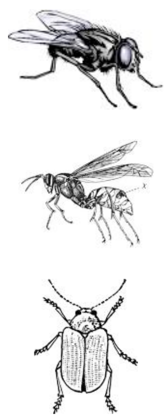
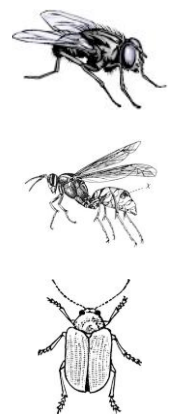
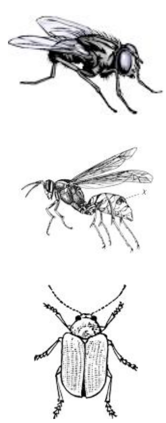
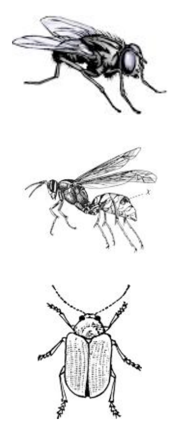
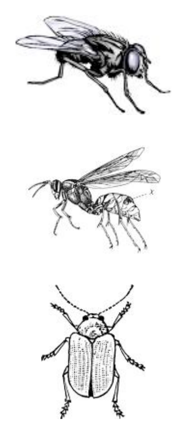
Producers



Go Fish

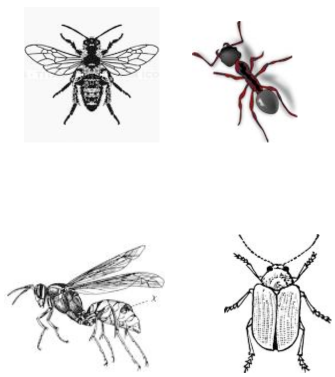
Pollinators 	Pollinators 	Pollinators 
Pollinators 	Pollinators 	Pollinators 

Go Fish

Decomposers 	Decomposers 	Decomposers 
Decomposers 	Decomposers 	Decomposers 

Go Fish

Soil Tillers



Soil Tillers

Soil Tillers

Soil Tillers

Soil Tillers

Soil Tillers

Go Fish

Population Controllers 	Population Controllers 	Population Controllers 
Population Controllers 	Population Controllers 	Population Controllers 

(To be used with Science Exploration 4-1)
Kinesthetic – Activity 5

Bee Boogie

Materials

- Paper or plastic flowers for each "hive"
- Dance directions
- Optional book, *Bees Dance and Whales Sing: The Mysteries of Animal Communication,* by Margery Facklam
- A space to "dance"

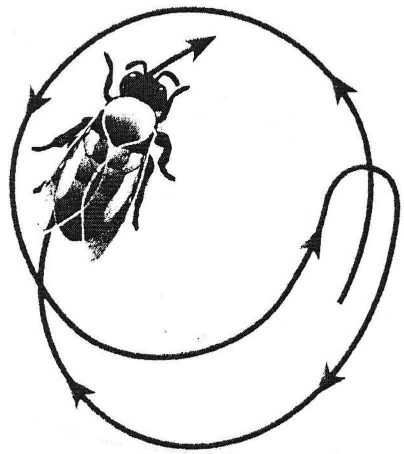
Activity

1. Discuss with students how honeybees communicate to one another by "dance" in order to do their job of pollinating. (One of the seven wonders of the animal world is that honeybees communicate to each other to indicate the whereabouts of nectar-filled flowers via a "bee boogie" dance. To convey that flowers are near the hive (within 300 feet), the scout honeybee circle-dances in a tight circle, reversing direction back and forth. To share the direction and distance of flowers far from the hive, the scout dances in a waggle dance, moving in a figure eight pattern, wagging her abdomen from side to side. The faster she waggles, the farther away the flowers are.)
2. Optional: Read the book, *Bees Dance and Whales Sing: The Mysteries of Animal Communication.*
3. Encourage students to practice the Circle Dance and the Waggle Dance together. (See dance directions.)
4. Have students play Bee Boogie by sending two "hives" of children out in the hallway after they have been shown the color flowers they will look for. Assign two groups of students to be the "scouts" who go into the room to hide the two sets of flowers.
5. Have the "hives" from the hallway return to the room and the "scout" honeybees for each hive dance to indicate direction and distance of each set of flowers for each "hive." Declare the "hive" that discovers their flowers first the winner.

Bee Boogie Dance Directions

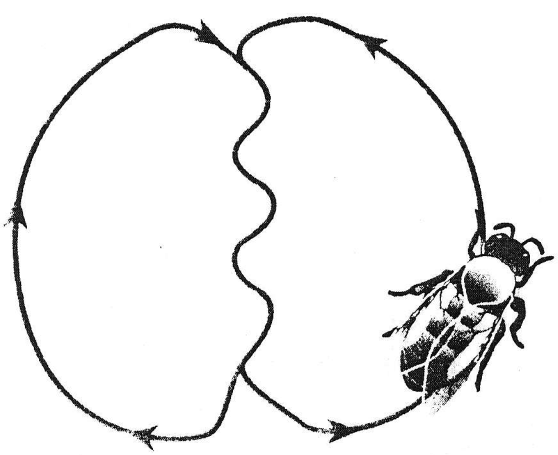
The Circle Dance

- To convey that flowers are near the hive (within 300 feet) the scout honeybee walks in a tight circle, reversing direction back and forth



The Waggle Dance

- To share the direction and distance of flowers far from the hive, the scout honeybee dances in a waggle dance, waggling her abdomen from side to side in a figure eight pattern. The farther the flowers are from the hive, the faster she waggles.



(To be used with Science Exploration 4-1)
Kinesthetic – Activity 6

Insects and Birds

Materials

- No materials are needed for this activity, other than a large, open space for movement.

Activity

1. Pick two students to be the birds and all the rest of the students are the insects.

2. When the birds yell "Insects Go," have the insects cross to the other side of the playing field without getting tagged.

3. If they get tagged, tell them that they are now birds and must try to help the other birds eat (tag) the insects.

4. Have play continue until there are no insects left in the game.

5. Facilitate a discussion of how the population of insects affects the population of birds.

Insect Job Description

Job 1 – pollinator; Job 2 – producer; Job 3 – decomposer;

Job 4 – soil tiller; Job 5 – population controller

I am a bumblebee.

I am gold and black. As I move from flower to flower, I become covered in pollen. The "baskets" on my hind legs are full of yellow or orange pollen. Some of this pollen comes off as I visit other flowers.

MY JOB 1 2 3 4 5

I am an ant.

I am small but work very hard as I dig tunnels in the soil. These tunnels let nutrients and water get into the ground. This makes it easier for plants to grow in the soil.

MY JOB 1 2 3 4 5

I am a dragonfly.

My nickname is "mosquito hawk." I deserve this name because I eat lots of mosquitoes. As an adult, I catch these mosquitoes in flight. When I was young, I swam in the water and ate the young mosquitoes that also lived there.

MY JOB 1 2 3 4 5

Job 1 – pollinator; Job 2 – producer; Job 3 – decomposer;

Job 4 – soil tiller; Job 5 – population controller

I am a honeybee.

I am yellow and black and I live in a hive with lots of other honeybees. We care for our young. We make lots of honey, enough to share with others.

MY JOB 1 2 3 4 5

I am a maggot.

I look like a worm but I am really a young fly. I eat decaying plants and dead animal parts.

MY JOB 1 2 3 4 5

I am a Monarch butterfly.

I am very pretty. I am orange and black. As I flit from flower to flower in search of nectar for food, I become covered in pollen. I lay my eggs on milkweed because that is the only thing my young caterpillar will eat.

MY JOB 1 2 3 4 5

Job 1 – pollinator; Job 2 – producer; Job 3 – decomposer;

Job 4 – soil tiller; Job 5 – population controller

I am a dung beetle.

I am dull black often with a green or copper sheen. I roll animal droppings (dung) into balls. We put these balls in tunnels in the ground where we feast on them and later feed them to our young.

MY JOB 1 2 3 4 5

I am a praying mantis.

I get my name from my front legs that look like hands held in prayer. These "hands" are really used to catch prey such as grasshoppers, flies, and caterpillars that become my supper.

MY JOB 1 2 3 4 5

I am an aphid.

I am a tiny, pear-shaped insect that sucks juices of plants. I make a sweet "lemonade" for ants called honeydew.

MY JOB 1 2 3 4 5

Insects at Work in Our World

Entomologist____

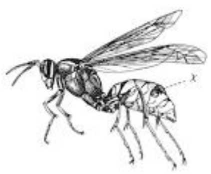
Circle the **decomposers** with your **black** crayon.

Circle the **pollinators** with your **yellow** crayon.

Circle the **soil tillers** with your **brown** crayon.

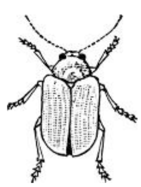
Circle the **producers** with your **red** crayon.

Circle the **population controllers** with your **green** crayon.







Dear Chaperones,

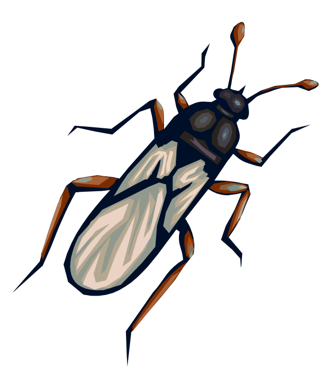
Thank you for your willingness to join us on our trip to Fermilab. We will be leaving the school at _________ on _________________ and would like you to be at school by _________ so we can give last minute instructions before we board the buses. We will remain as a whole group throughout the trip but you will be keeping an eye on and assisting a small group of students within the large group.

When we arrive at Fermilab, we will be visiting three different stations. A Fermilab docent will lead each class as we look for "Life in a Log" in the woods, sweep for "Pollinators on the Prairie," and search for "Waders in the Water." It is a "hands-on" trip and we will need you to be an active participant with the students since they will need your help to locate, observe and even catch insects.

To give you a better understanding of what we will be doing on the trip, we have attached the lesson plan, graphing sheet and student reflection questions that go along with each station we will visit while at Fermilab.

Thank you again for volunteering your time. Please don't forget to dress for the weather, as we will be outside the entire time.

Thank you!



Science Exploration 5-1

Pollinators on the Prairie

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.
- The five main jobs of insects are decomposers, pollinators, soil tillers, producers and pest controllers.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Use sweep nets to collect insects from the field.
- Identify insects in the prairie and distinguish them from non-insects.
- Classify insects in the prairie according to orders.

Materials

- Sweep nets (small)
- Bug boxes with magnifying lids
- White observation cloth
- Pollinator in the Prairie data sheets, pencils and crayons

Background

Flying and crawling insects are vital to the success of any plant community. They pollinate the plants, are a food source for many other organisms and help control insect populations. There are many different insects found on the Fermilab site. The more diverse plant population at Fermilab may account for a greater variety of insects.

Many very small insects may be missed without careful observation. It is interesting to note that many seemingly identical bugs on close observation are different. Most of the insects found in Illinois belong to one of the eight common insect orders discussed in Chapter 2:

- Bees, wasps and ants
- Beetles and weevils
- Butterflies and moths
- Grasshoppers and crickets
- Hoppers and cicadas
- Flies and mosquitoes
- Dragonflies and damselflies
- True bugs

Spiders are often collected while sweeping for insects. Because they have eight legs and two body parts, spiders are easily distinguished from insects.

Factors other than prairie habitat that may influence what the students collect include: temperature, rainfall, and presence of other activity in the area such as many other students collecting or walking through the area, or perhaps recent controlled burns in the area.

Field Time

Engaging the Students

- Bring students to the prairie site where, acting as amateur entomologists, they will be sweeping for insects.
- Facilitate a discussion about the site. (What do the students notice about the prairie? How is the prairie different from their yards and the schoolyard? Do they think they will find more insects in their yard or in the prairie? Will they find all the same insects or different insects in the prairie? What other critters might they find in the prairie? What jobs are insects performing in the prairie?)
- Divide students into working groups and give each group a sweep net, bug boxes with magnifying lids, a white observation cloth, and a data sheet and each student a magnifying lens.

Investigation

Students will:

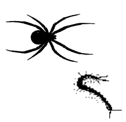
- Take turns using the sweep nets to collect insects from the prairie and dump the insects collected onto the observation cloth.
- Catch as many of the critters collected as they can and place them in the bug boxes.
- Observe the critters in the boxes and decide which are insects and which are insect relatives.
- Using the pictures on the data sheet and assisted by the chaperones, look closely at the insects to determine in what order each insect belongs.
- With the help of chaperones, record their findings on the data sheet.

Sharing and Summarizing

- Discuss findings with each group of students. (Did they find more insects here or in their schoolyard? What are some factors that may influence what insects are present?)
- Give data sheets to the teacher for further study in the classroom. (Copies of the data sheets may be added to the science journals.)
- After returning to school, compare findings of all the groups and facilitate further discussion. (See Student Reflection page.)
- Revisit the jobs performed by entomologists and add to the model.

Pollinators on the Prairie

Color in one square for each insect collected. Entomologists________________________________

Beetles Weevils													
Stink Bugs Milkweed Bugs													
Bees Wasps Ants													
Butterflies Moths													
Grasshoppers Katydids Crickets													
Planthoppers Leafhoppers Cicadas													
Flies Mosquitos													
Dragonflies Damselflies													
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Non-insects													

Student Reflection Possible Responses: Pollinators on the Prairie

1. How many different kinds of insects did you see?
   How many different kinds of critters did you see?
   How were they different from one another?
   Answers may include different colors, sizes, shapes, etc.

2. Which insect did you see most often?

3. What jobs were the insects performing?
   Pollinating, soil tilling, pest controlling likely answers.

4. Which insect did you like the best? Why?

5. Which insect did you like the least? Why?

6. Did you observe mostly insects or relatives of insects? How could you tell the difference?
   Number of legs (6), number of body parts (3) will define insects. (Spiders have eight legs and two body parts and are common.)

Science Exploration 5-2

Life in a Log

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.
- The five main jobs of insects are decomposers, pollinators, soil tillers, producers and pest controllers.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Identify insects in a log and distinguish them from non-insects.
- Classify insects in a log according to orders.

Materials

- Craft sticks to use for digging
- Bug boxes with magnifier
- Life in a Log data sheets, pencils and crayons

Background

In a natural wooded area, decomposing logs and leaf litter are in the process of returning food and nutrients to the soil. Insects and their relatives aid fungi and other organisms in this decomposition. They make homes in and under the logs and under the bark of the log.

Decomposers visible to the naked eye are usually present when observing fallen logs. Many of these may be insect relatives such as millipedes, centipedes, mites, spiders and earthworms. Others are insects. Close examination of the specimens collected is important because beetle larvae are common in this habitat and may be confused with worms, millipedes or centipedes. Count the legs! Most children will immediately recognize a “roly-poly,” but is it an insect? Recalling the definition of an insect as having six legs, three body parts, and two antennae is helpful in properly identifying the decomposers.

Field Time

Engaging the Students

- Bring students to a site with fallen, rotting logs where, acting as amateur entomologists, they will be searching for insects and their relatives.
- Facilitate a discussion about the site. (What do the students notice about the site? Do they think they will find more insects in their schoolyard or in the woods? Will they find many of the same insects or different kinds of insects in the woods? What jobs do they think the insects are performing? What other critters might they find in the woods?)
- Divide students into working groups and give each group several bug boxes and each student a craft stick.

Investigation

Students will:

- Observe a rotting log noting critters, plants and condition of log. (How much decomposition has taken place? How wet or dry is the log?)
- Collect any critters they find on the log, under the bark and under the log, and place them in the bug box.
- Observe the critters carefully and decide which are insects and which are insect relatives.
- Using the pictures on the data sheet and assisted by the chaperones, look closely at the insects to determine in what order each insect belongs.
- With the help of the chaperones, record their findings on the data sheet.

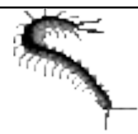
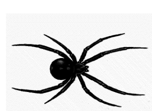
Sharing and Summarizing

- Discuss findings with each group of students. (Did they find more insects here or in their schoolyard? What are some factors that may influence what is present?)
- Give data sheets to the teacher to be used for further study in the classroom. (Copies of the data sheets may be added to the science journals.)
- After returning to school, compare findings of all the groups and facilitate further discussion. (See student reflection page.)
- Revisit the jobs performed by entomologists and add to the model.

Life in a Log

Color in one square for each insect or insect relative you collect.

Entomologists________________________________

Beetles Beetle larvae													
Bees Wasps Ants													
Flies Mosquitoes													
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Earthworms and Other Critters													
Centipedes													
Millipedes													
Mites													
Spiders													

Student Reflection Possible Responses: Life in a Log

1. How many different kinds of critters did you see? How were they different?
   May be different color, sizes, shapes etc.

2. Which critter did you see most often?
   Ants, beetles or spiders likely answer

3. Did you find different critters under the log and in the dirt than you found on the log? Why?
   They are different habitats.

4. What plants were on or under the log? Do you think they helped the insects do their jobs? If so, how did they help?
   Moss, lichen, etc. The roots penetrated the wood, making it easier for insects to get deep into the wood. They help with decomposition.

5. Did you observe mostly insects or relatives of insects? How could you tell the difference?
   Number of legs, number of body parts will define insects. (A "worm" with six legs is actually an insect larva.)

6. What jobs were the insects performing?
   Decomposing, controlling populations, soil tilling likely answers

Science Exploration 5-3

Waders in the Water

Essential Knowledge

- Entomologists are scientists who study insects.
- Insects have characteristic structures and behaviors that separate them from their closest relatives.
- Insects are divided into groups according to similarities and differences.
- The five main jobs of insects are decomposers, pollinators, soil tillers, producers and pest controllers.

Skills

1. Observing:
   a. Scientists use observation as a powerful tool to learn about nature.
   b. Scientists keep detailed and accurate records of their work.
2. Using tools in science:
   a. Scientists use field guides and models to learn about and identify things in nature.
   b. Scientists use magnifying lenses and microscopes to examine objects closely and see details they might not see otherwise.
3. Communicating:
   a. Scientists work in cooperative groups to discuss observations and ideas.
   b. Scientists keep a record of their findings by writing detailed descriptions and making accurate drawings.
   c. Scientists share descriptions of their work with others.
4. Comparing and organizing:
   a. Scientists use knowledge gained from discussion to add to their journals.
   b. Scientists organize objects according to their similarities and differences.

Learner Outcomes

Students will be able to:

- Identify insects in the water and distinguish them from non-insects.
- Assess the quality of the wetland by what critters are present in the water.

Materials

- Tubs filled with water sample from wetland
- Trays filled with water and rocks from wetland
- Spoons
- Bug boxes with magnifying lids
- Water identification reference sheet
- Waders in the Water data sheets, pencils and crayons
- "How Clean is the Water?" specie indicator sheet

Background:

Hundreds of species of wildlife, mammals, birds, fish and invertebrates are found at Fermilab. Some of these species live in and around the wetland areas. Examining invertebrates living in the water can help determine the quality of the wetland. An investigation of the rocks just below the riffle (where water tumbles over an obstruction such as a rock or dam) reveals evidence of even more animal life.

A wide diversity of invertebrates generally indicates better water quality. However, the specific types present need to be considered because some invertebrates are more tolerant of pollution than others. Simple biological indicator charts have three categories of invertebrates. Level I species demand a nearly pristine environment while Level II species require relatively clean water. Level III species may be present in most bodies of water because they are able to live in relatively impure waters. Most of the specie indicators found at Fermilab are in Level II and III indicating that the wetlands are relatively clean. (Level II species will not be present if the water is impure.) Check out this website for information about benthic (organisms large enough to be seen by the naked eye) species and their importance to monitoring water quality.
http://www.epa./bioindicators/html/benthosclean.html

Field Time

Engaging the Students

- Bring students to a site next to the wetland where tubs filled with water samples and trays filled with water and rocks from the wetland have been set up.
- Facilitate a discussion about the site. (What do the students notice about the wetland? Do they think they will find insects in the water? What other critters might they find in the water? What job do they think these critters are performing?)
- Divide students into working groups and give each group several bug boxes and each student a plastic spoon.

Investigation

Students will:

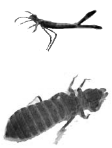
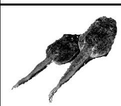
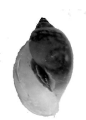
- Scoop the organisms from the water into a bug box or tray.
- Check for organisms clinging to the rocks.
- Observe and, with the help of an adult, identify their specimens using pictures on data sheet and water ID sheet.
- Record their findings on the data sheet with the help of a chaperone.
- Return all organisms to the tub.

Sharing and Summarizing

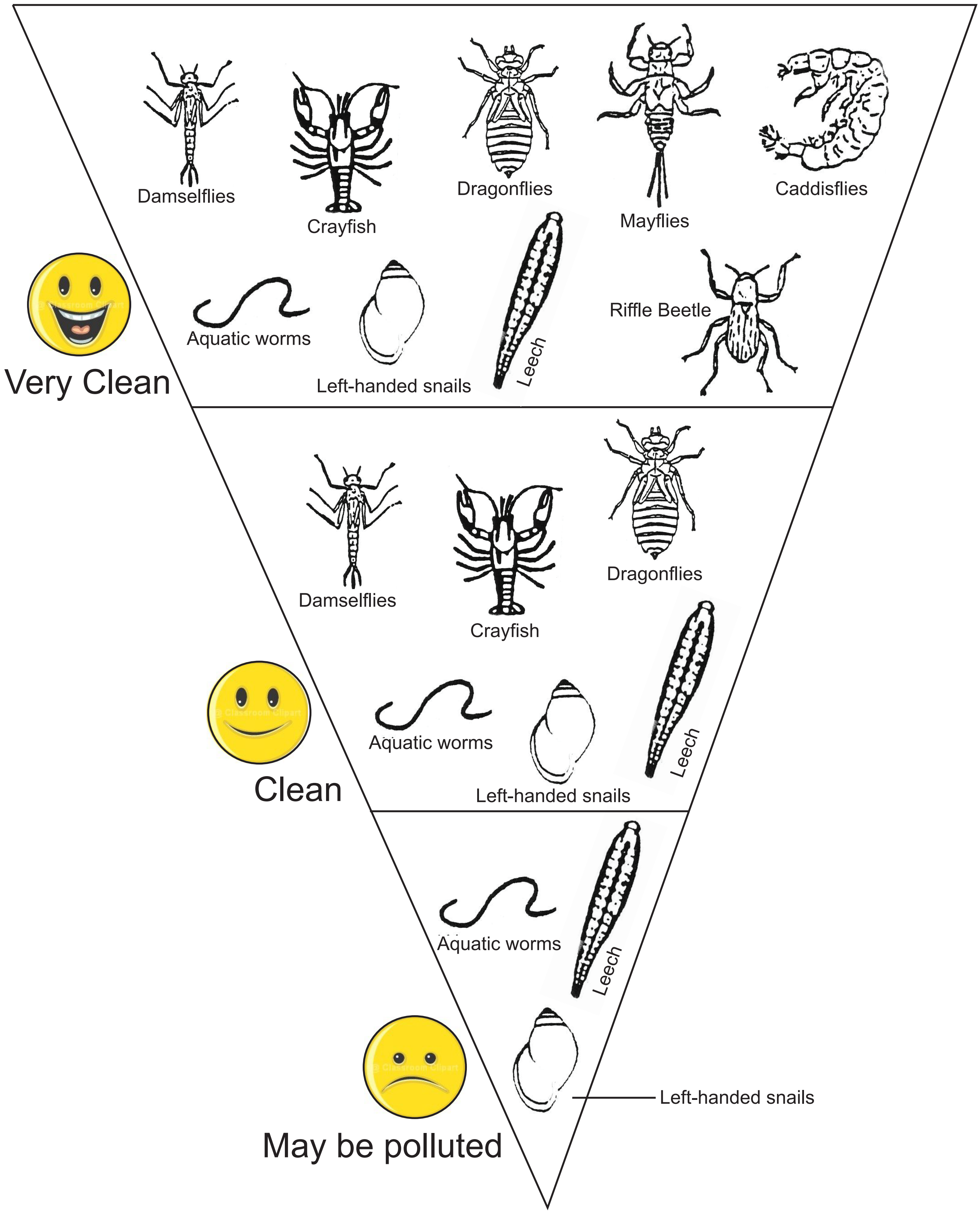
Discuss findings with each group of students. (Did they find many insects? Many insect relatives?) Share “How Clean is the Water?” specie indicator sheet with the students and help them determine the likely condition of the wetland.)
Have chaperones note likely condition (Very Clean, Clean, May be Polluted) of the wetland on the specie indicator sheet.
Have chaperones give the data and specie indicator sheets to the teacher so that he/she may make copies for each student to keep in their science journal.
After returning to school, compare findings of all the groups and facilitate further discussion. (See Student Reflection page.)
Revisit the jobs performed by entomologists and add to the model.

Waders in the Water

Color in one square for each water critter collected.   Entomologists______________________________

Water Boatmen													
Dragonfly and Damselfly Nymphs													
Adult Beetles Beetle Larvae													
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Tadpoles													
Leeches													
Worms													
Snails													
Other critters													

How Clean is the Water?



Student Reflection Possible Answers: Waders in the Water

1. How many different kinds of critters did you see? How were they different?
   May be different colors, sizes, shapes, etc.

2. Which critter did you see most often?

3. What job were the critters performing?
   Possible answers include controlling populations, indicating water quality.

4. Which critter did you like the best? Why?

5. Were any of the critters insects? Worms?

6. Would you say the water sample indicates a healthy wetland?
   Health of the wetland may be determined by the presence of organisms. If students found organisms present on the sheet, "How Clean is the Water?," they may be able to assess the cleanliness of the wetland.

Insects and Language Arts
(Lesson 6-1)

Purpose
While learning to write different styles of poetry and sing short songs, students recall some of what they have learned about insects.

Objectives
Students will:
- Read and listen to poetry with an insect theme.
- Sing songs with an insect theme.
- Write a Haiku, Cinquain and Windspark poem.

Background
Poems allow the students to think about insects and write their feelings to share with others. Many students remember facts better when they sing them or hear them sung. Young children particularly benefit from repetition in order to remember facts they have been taught and enjoy learning through poetry and song.

Materials
- Collection of poems and songs with an insect theme
- Activity 1: Insect Haiku
- Activity 2: Cinquain
- Activity 3: Windspark

Activity
1. Read selected poems to class.
2. Sing selected songs with students.
3. Have students write a haiku.
4. Have students write a cinquain.
5. Have students write a windspark.

Every Insect

by Dorothy Aldis

Every insect (ant, fly, bee)
Is divided into three:
One head, one chest, one stomach part.
Some have brains,
And all have a heart.

Insects have no bones
No noses.

But with feelers they can smell
Dinner half a mile away.
Can your nose do half as well?

Also, you'd be in a fix
With all those legs to manage: six!

Bugs

By Meish Goldish

(Tune: When The Saints Go Marching In)

Oh, when the bugs go marching in,
Oh, when the bugs go marching in,
Oh, how I'll see the ants and the beetles
Oh, when the bugs go marching in.

Oh, when the bugs begin to crawl,
Oh, when the bugs begin to crawl,
Oh, how I'll see the roaches and termites,
Oh, when the bugs begin to crawl.

Oh, when the bugs come flying in,
Oh, when the bugs come flying in,
Oh, how I'll see the moths and mosquitoes,
Oh, when the bugs come flying in.

Oh, when the bugs begin to buzz,
Oh, when the bugs begin to buzz,
Oh, how I'll hear the bees and cicadas,
Oh, when the bugs begin to buzz.

Oh, when the bugs begin to leap,
Oh, when the bugs begin to leap,
Oh, how I'll see the fleas and the crickets,
Oh, when the bugs begin to leap.

Butterfly, Butterfly

By Jan Warren

Butterfly, butterfly, laying lots of eggs.

The eggs hatch caterpillars with short, stubby legs.

Caterpillar, caterpillar, eating 'til you're big.

Then walking very slowly . . . you hang from a twig.

Sleep now, and change, but very, very soon . . .

Caterpillar, caterpillar, you changed, you didn't die.

You grew wings, and long legs, to become a

beautiful butterfly!

Caterpillar Song

(Tune: Yankee Doodle)

I started as a tiny egg
Upon a leaf of green.
And now I stay upon the leaf
So I will not be seen.

Soon I'll build a chrysalis
Upon a limb up high.
I'll stay awhile and then come out
And be a butterfly!

Caterpillars

What do caterpillars do?
Nothing much but chew and chew.

What do caterpillars know?
Nothing much but how to grow.

They just eat what by and by
Will make them be a butterfly.

But that is more than I can do
However much I chew and chew.

-Aileen Fisher

Crickets

What makes the crickets "crick" all night

And never stop to rest?

They must take naps in daytime

So at night they'll "crick" their best.

I wonder if they just take turns

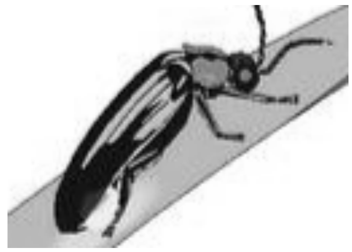
And try to make it rhyme

Or do a million crickets

Keep "cricking" all the time?

Firefly

By Meish Goldish



Firefly, firefly,
Wow, how you glow!
Under your body
You light up below!
Firefly, firefly
Wow, how you shine!
At night in the dark
I can see you just fine!

Five Fuzzy Caterpillars

By Margaret Allen

Five fuzzy caterpillars on a spring day.

(Hold up five fingers.)

Five fuzzy caterpillars crawl and play.

(Crawl five fingers on arm.)

Five fuzzy caterpillars eat and eat some more . . .

(Make chewing noise.)

Five fuzzy caterpillars we can see no more . . .

(Hold hand above eyes and look around.)

Each in a chrysalis they will stay, 'til they are butterflies and fly away!

(Place thumbs together and spread fingers out and "fly.")

I'm a Little Ladybug

(Tune: I'm a Little Tea Pot)

I'm a little ladybug, as you see.
I am a beetle, pretty as can be.
I am brightly colored, red and black.
Look at the pretty spots on my back!

- Author Unknown

Insect Bodies!

By Victoria Smith

(Tune: If You're Happy and You Know It)

Every insect's body has three parts.
Yes, every insect's body has three parts.
Every insect has a head,
A thorax and abdomen.
Every insect's body has three parts.

Every insect's body has six legs.
Yes, every insect's body has six legs.
They have three legs on each side,
And they walk on them with pride.
Every insect's body has six legs.

Insects All Around

(Tune: Twinkle, Twinkle, Little Star)

Ladybugs and butterflies,

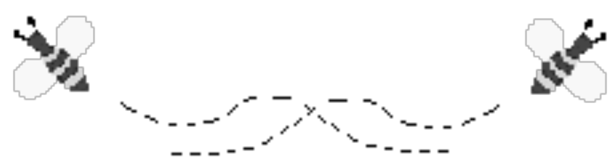
Buzzing bees up in the sky.

Teeny, tiny little ants,

Crawling up and down the plants

Many insects can be found

In the sky and on the ground.



Look! I'm a Butterfly!

Sing Along
(Sung to the tune of "Pop Goes the Weasel")

I spin and spin my chrysalis,
(Circle fingers on palm.)

Then go to rest inside.
(Close fingers and rest hand on palm.)

When I come out,
I've changed indeed . . .
(Open fingers slowly.)

Look! I'm a butterfly!
(Fly fingers away.)

Mealworm Poem

My mealworm likes to crawl around
And eat up all its flakes.
It may not look so cute just yet,
But wait to see what nature makes!

Right now it's in its larval stage.
It wiggles and it's small.
And soon it's very, very still.
It does not move at all.
This is called the pupa stage when it takes a rest.
Soon it changes how it looks.
It's a beetle at its best!

Six Buzzing Bumblebees

Susan M. Paprocki

Six buzzing bumblebees
Flying around the hive,
One buzzes off and that leaves five.
Five buzzing bumblebees
Flying near my door,
One buzzes off and that leaves four.
Four buzzing bumblebees
Flying around a tree,
One buzzes off and that leaves three.
Three buzzing bumblebees
In the sky so blue,
One buzzes off and that leaves two.
Two buzzing bumblebees
Flying by the sun,
One buzzes off and that leaves one.
One buzzing bumblebee
Looking for some fun,
It buzzes off and that leaves none!

The Busy Ant

By Mary Ann Hoberman

The busy ant works hard all day
And never stops to rest or play.
He carries things ten times his size,
And never grumbles, whines or cries.
And even climbing flower stalks,
He always runs, he never walks.
He loves his work, he never tires,
And never puffs, pants or perspires.

Yet though I praise his boundless vim
I am not really fond of him.

The Insect Song
(Tune: London Bridge)

Every insect has 3 parts,
has 3 parts, has 3 parts.
Every insect has 3 parts,
I can name them all!

Head and thorax, abdomen,
abdomen, abdomen.
Head and thorax, abdomen,
An insect has 3 parts!

Every insect has 6 legs,
has 6 legs, has 6 legs.
Every insect has 6 legs,
Count them all to see!

Every insect has antennae,
has antennae, has antennae.
Every insect has antennae,
That is how they smell!

Insects usually have some wings,
have some wings, have some wings.
Insects usually have some wings,
That is how they fly!

Every insect has 3 parts,
has 6 legs, has antennae.
Every insect has these things,
Some even have wings!

M. Hubbard

(To be used with Lesson 6-1)
Activity 1

Insect Haiku

Material

- Haiku practice sheet
- Paper and pencil
- Chart paper and markers

Activity

1. Tell students that a haiku is a three-line poem in which line one has five syllables, line two has seven syllables and line three has five syllables. (Review syllables.)
2. Practice a group insect haiku poem with the class on chart paper.
3. Have students write their own insect haiku.

Insect Poet _______________

Insect Haiku Practice Sheet

Look at the haiku below. Underline the syllables in each line.

A chrysalis hangs
From the branches, it's changing.
A beautiful sight!

Practice your own haiku. Remember, line one has five syllables, line two has seven syllables and line three has five syllables. Good luck!

____

____

____

(To be used with Lesson 6-1)
Activity 2

Cinquain

Material

- Paper and pencil

Activity

- Tell students that they will be composing a five-line poem called a cinquain and have them decide what insect they would like to write.
- The first line is one to two words and is the title of the poem. (Example: name of the insect)
- The second line has two words that describe the title. (Example: color, size)
- The third line has three words ending in "ing" that tell what the insect is doing.
- The fourth line has four words that describe how the insect makes you feel.
- The fifth line has one or two words renaming the insect. (The poet gets to choose the name.)

<u>Example</u>:
Grasshopper
Long-legged, green
Hiding, chewing, hopping
It makes me jumpy.
Jack

(To be used with Lesson 6-1)
Activity 3

Windspark

Material

- Paper and pencil

Activity

1. Tell students that they will be composing a five-line poem called a windspark.
2. Explain that a windspark poem has the following pattern:

	Example
I dreamed	**I dreamed**
What?	**I was a dragonfly**
Where?	**Near the pond**
An action	**Sitting on a cattail**
How?	**Gracefully**

My Windspark Poem

I dreamed

I was ___________________________

Poetry Rubric

Creativity	**Chose unusual unique words**	**Chose some unusual words**	**Chose typical words**
Effort	**Did more than was expected**	**Tried your best**	**Need to work a little harder**
Spelling	**No errors**	**1 error**	**More than 1 error**
Clarity	**Very easy to understand**	**Makes sense**	**Not clear**

(Assessment for Unit)

Insect Research

Purpose

To familiarize students with the different text features found in nonfiction books and to introduce them to the process of researching and reporting on a given topic.

Objectives

Students will:

- Identify various text features found in nonfiction books: headings, captions, labels, bold print, table of contents, index, glossary, charts, graphs, maps, etc.
- Use simple research techniques and various text features to create a nonfiction book about common insects.

Background

Research doesn't just begin in high school. Very young children can be found "researching" many topics as they exclaim over the pictures or simple text in nonfiction books, even though those particular books may be written well beyond their reading level. These students are engaged in research or the gathering of information about a topic. These students are highly motivated by their interest and teachers can capitalize on that interest and enthusiasm and begin to introduce these young learners to early research skills that can continue to be built upon as the students progress through elementary school. By the upper elementary grades, research will have become a major part of children's academic experiences. In the early school years, research can be done by the whole class or can be teacher-directed as determined by the children's skill level. Beginning to learn the steps of how to do a research report—how to take good notes, how to paraphrase, how to locate material in a library, how to outline, and how to pull lots of information into a compelling final product—can only benefit the scientists of the future.

Materials

- Various nonfiction books that contain different text features: headings, captions, labels, bold print, table of contents, index, glossary, charts, graphs, maps, etc.
- Many nonfiction insect books at an appropriate reading level for your students
- Chart paper
- Lined story paper with space for an illustration at the top
- Preprinted title page or blank paper for student-created title page
- Pencils/crayons

Note

This lesson will take several class periods to complete and should be adapted to fit the grade level and the skill level of the students in the class. For first grade students, the research may be done as a whole group with each student completing their own individual book based on the findings of the group. As abilities allow, first-graders may be able to complete a page or two of their book independently. Second grade students may be more able to complete the research on their own.

Activity

Part One:

1. Show students both a fiction book and a nonfiction book and discuss the differences between the two.
2. Explain that nonfiction books are used when gathering factual information and point out and define for them the different text features included in the book: headings, captions, labels, bold print, table of contents, index, glossary, charts, graphs, maps, etc.
3. Explain the importance of reading the text features, as they are there for the purpose of giving the reader more information about the given topic.
4. Distribute various nonfiction books. (Each student has his/her own or partners may work together.) Challenge students to find as many different text features as possible in the book they have.
5. Gather the group together and ask for volunteers to share the text features they found.

Part Two:

1. Share with students that they will be doing research on various insects and will be using the information they gather to create a book.
2. If completing the research as a group, select together three to five insects that will be studied. (If students are able to do the research independently, they may select their own insects.)
3. Read aloud information about one of the chosen insects. Chart facts about the insect as you go through the book, showing students how to paraphrase the given information.
4. Allow students time to search nonfiction books for more information about the given insect. Add information found to the chart.
5. Over a series of days, repeat the same procedure for the three to five different insects.
6. Using the charts of information, determine which facts listed students would like to include in their report about each particular insect. Depending on the ability level of the students, have students copy the same information or allow students to choose which facts they use on their own.
7. Have students complete one page on each insect by listing three to four facts and drawing a picture of the insect.
8. When all pages are complete, determine with students the different text features to be added to each page. For example, on a page about bees, the heading "Bees" should be added to the top. One of the facts on the page might read, "Bees help to pollinate plants," and the word **pollinate** could be darkened to create a bold word. The caption, "This bee is pollinating a flower," could be written below the picture of a bee on a flower.
9. When text features have been added to each page, have students write and define any bold words on a blank page to create a glossary for the back of the book.
10. Help groups determine which words will be used to create an index page.
11. Show students how to organize the pages of their book into the order they choose with the index and glossary at the back. Page numbers should be added.
12. Have students create a Table of Contents page listing the heading for each page along with the page number.
13. Staple or bind the nonfiction books with a preprinted title page or allow students time to create their own title page.

Insect Vocabulary Words

Abdomen - The rear part of an insect's body, attached to the thorax.

Antennae - The long feelers on an insect's head, used for smelling, detecting movements or moisture.

Arthropod - An animal with hard, jointed legs. Includes insects, crabs, centipedes and spiders.

Burrow - To dig a hole in the ground.

Camouflaged - Colored or patterned to blend in with the background.

Caterpillar - The larva of a butterfly or moth.

Cerci - Paired sensory appendages located at the back of the abdomen on some insects.

Chrysalis - The pupa of a butterfly.

Cocoon - A silky case that a larva, moth or other insect forms to protect itself while going through the pupa stage.

Complete metamorphosis - Insect development that includes the stages of egg, larva, pupa and adult.

Compound Eye - An eye made up of many smaller, individual eyes called facets.

Decomposer - An insect that eats dead materials.

Drone - Male honeybee.

Entomology - The study of insects. Scientists who study insects are called entomologists.

Exoskeleton - The hard outer covering on an insect's body.

Grub - The wormlike larva of some insects, especially beetles.

Habitat - The environment in which an organism lives.

Insect - A small arthropod with three body parts, three pairs of legs, two antennae, and usually one or two sets of wings.

In-star - Stages between molts in an insect. An insect that hasn't molted is in the first in-star.

Invertebrate - An animal without a backbone. An insect is an invertebrate.

Larva - The second stage of complete metamorphosis.

Life Cycle - A repeating process of birth, growth, reproduction and death that occurs among every living species.

Metamorphosis - The process that an insect goes through as it changes from the immature stage to the adult stage.

Migrate - The movement from one region to another at certain times of year.

Molting - The shedding of the insect's outer layer as the insect grows.

Naiad - The aquatic nymph of some insects.

Nectar - A sugary substance produced by flowers.

Nymph - The second stage of incomplete metamorphosis. Nymphs usually look like the adults.

Organ - A part of the body, such as the heart, that performs a particular function.

Organisms - Living things such as a plant, an animal or bacteria.

Palpi - Paired sensory appendages of the mouthpart.

Parasite - An animal that lives and feeds on another animal.

Pollinator - An organism that moves pollen from one plant to another plant.

Predators - Animals that hunt other animals for food.

Prey - An animal that is hunted and eaten by another animal.

Proboscis - A long tube that is part of an insect's mouth used for drinking and piercing plant matter.

Producers - Insects that make a product such as honey or silk.

Pupa - The third stage of complete metamorphosis. The insect is inactive during this stage.

Queen - The only egg-laying female in a nest of social insects, such as termites or bees.

Segments - The divisions of an insect's abdomen.

Soil Tillers - Insects that aerate the soil while digging homes for food.

Species - A group of organisms of like characteristics.

Thorax - The middle part of an insect's body located between the head and abdomen. The wings and legs are attached to the thorax.

Tympanum - An organ used for “hearing” consisting of a vibration-sensitive membrane on the abdomen or forelegs of grasshoppers, cicadas, and some moths.

Wing Cases - Hard outer wings that are not used for flying.

Bibliography
May 10, 2016

Aloian, Molly & Kalman, Bobbie. *Helpful and Harmful Insects: The World of Insects.* New York, NY: Crabtree Publishing Company, 2005.

Aloian, Molly. *How Are Insects Helpful?* New York, NY: Crabtree Publishing Company, 2014.

Aloian, Molly. *Life Cycles of Insects: Insects Close-Up.* New York, NY: Crabtree Publishing Company, 2014.

Aloian, Molly. *What is an Insect?* New York, NY: Crabtree Publishing Company, 2014.

Bernard, Robin. *Life Cycle of a Butterfly.* New York, NY: Scholastic, Inc., 1995.

Bodden, Valerie. *Creepy Creature Series: Ants, Beetles, Crickets, Stick Insects, etc.* Mankato, MN: Creative Paperbacks, 2014.

Dussling, Jennifer. *Bugs! Bugs! Bugs!* New York, NY: DK Publishing, Inc., 1998.

Ehlers, Sandy McCartney. *Wings of Magic.* Spicer, MN: Ehlers Press, 1992.

Facklam, Marjery. *Bees Dance and Whales Sing: The Mysteries of Animal Communication.* San Francisco, CA: Sierra Book Club for Children, 1992.

Facklam, Margery & Facklam, Paul. *Creepy, Crawly Caterpillars.* New York, NY: Little Brown and Company, 1996.

Fowler, Allan. *It's a Good Thing There Are Insects.* Chicago, IL: Children's Press Inc., 1990.

Goor, Nancy and Goor, Ron. *Insect Metamorphosis: From Egg to Adult*. New York, NY: Atheneum Macmillan Publishing Company, 1990.

Green, Emily K. *World of Insects Series: Cockroaches, Praying Mantis, etc.* Minneapolis, MN: Bellwether Media, 2007.

Guillain, Charlotte. *Acorn Series – Comparing Bugs: Bug Parts, Bugs on the Move, Bug Homes.* Chicago, IL: Heinemann Library, 2010.

Gustin, Tony. *Who Wants to be an Entomologist?* (CD), 2008.

Hadden, Sue. *Insects: Weird and Wonderful.* New York, NY: Thomson Learning, 1991.

Hartley, Karen, Macro, Chris and Taylor, Philip. *Bug Book Series – Ant, Beetle, Caterpillar, etc.* Oxford, UK: Reed Educational and Professional Publishing, 1999.

Holland, Gay W. *Look Closer: An Introduction to Bug Watching.* Connecticut: The Millbrook Press, Inc., 2003.

Hoose, Phillip and Hannah. *Hey, Little Ant.* New York, NY: Scholastic Inc., 1998.

Illinois Department of Natural Resources. *Wings, Stings and Leggy Things: Insects of Illinois.*

Jenkins, Martin. *Wings, Stings and Wriggly Things.* Cambridge, MA: Candlewick Press, 1996.

Llewellyn, Claire. *I Didn't Know That Some Bugs Glow in the Dark.* Brookfield, CT: Copper Beech Books, 1997.

McDonald, Megan. *Insects Are My Life.* New York, NY: Orchard Books, 1995.

Miller, Heather Lynn. *This is Your Lifecycle: With Special Guest Dahlia the Dragonfly.* New York, NY: Clarion Books, 2008.

Parker, Janice. *Insects: Life Science.* New York, NY: Weigl Publishers, Inc., 2008.

Parker, Nancy Winslow and Wright, Joan Richards. *Bugs*. New York, NY: Greenwillow Books, 1987.

Pyers, Greg. *Why Am I an Insect?* Chicago, IL: Raintree, 2006.

Rabe, Tish. *My, Oh My—A Butterfly! All About Butterflies: Cat in the Hat's Learning Library Series).* New York, NY: Random House Children's Books, 2007.

Rabe, Tish. *On Beyond Bugs! All About Insects: Cat in the Hat's Learning Library Series.* New York, NY: Random House Children's Books: 1999.

Richardson, Adele. *Insects.* Mankato, MN: Capstone Press, 2005.

Rockwell, Anne. *Bugs Are Insects.* New York, NY: Harper Collins Children's Books, 2001.

Rompella, Natalie. *Don't Squash That Bug! The Curious Kid's Guide to Insects.* Montreal, Quebec: Lobster Press, 2007.

Silverman, Buffy. *Can You Tell a Bee from a Wasp?* Minneapolis, MN: Lerner Publishing Group, Inc., 2012.

Silverman, Buffy. *Can You Tell a Cricket from a Grasshopper?* Minneapolis, MN: Lerner Publishing Group, Inc., 2012.

Souza, Dorothy M. *Insects in the Garden: Creatures All Around Us.* Minneapolis, MN: Carolrhoda Books, Inc., 1991.

Souza, Dorothy M. *Insects Around the House: Creatures All Around Us.* Minneapolis, MN: Carolrhoda Books, Inc., 1991.

Stewart, Melissa. *Insect or Spider? How Do You Know?* Berkeley Heights, NJ: Enslow Publishers, Inc., 2011.

Stone, Lynn M. *What Makes an Insect? Animal Kingdom.* Vero Beach, FL: The Rourke Book Co., Inc., 1997.

Taylor, Barbara. *Insects: Kingfisher Young Knowledge.* Boston, MA: Kingfisher Publications, a Houghton Mifflin Co., 2006

Zemlicka, Shannon. *From Egg to Butterfly.* Minneapolis, MN: Lerner Publications Co., 2003.

Field Guides

Borror, Donald J. and White, Richard E. *Insects. Peterson Field Guides.* Boston: Houghton Mifflin Company, 1970.

Dunn, Gary A., *Insects of the Great Lakes Region.* Ann Arbor, MI: The University of Michigan Press, 2001.

Levi, Herbert W. and Levi, Lorna R., *Spiders and Their Kin: A Golden Guide.* New York, NY: St. Martin's Press, 2002.

Milne, Loras and Milne, Margery. *National Audubon Society Field Guide to North American Insects and Spiders.* New York, NY: Alfred A. Knopf, Inc., 1980.

Zim, Herbert S. and Cottam, Clarence. *Insects: A Golden Guide.* New York: St. Martin's Press, 2001.

Websites

http://eddata.fnal.gov/lasso/insect_search/search_kids.html - Insects at Fermilab. (For pictures and descriptions, click on "Find All Insects.")

www.cirrusimage.com - Insect pictures. (PowerPoint pictures are from this site.)

www.insected.arizona.edu - Science and math activities that use live insects in elementary classrooms.

www.sciencespot.net/Pages/kdzinsect.html - Several links to background information for teachers as well as games and quizzes for students.

http://musicofnature.org/songsofinsects/iframes/twentyspecies.html - Hear the actual sounds of 20 different insects.

www.orkin.com/learningcenter/kids_and_teachers.aspx - Information on insects for teachers as well as games for students. (Schedule an Orkin man to come and visit your classroom!)

www.uky.edu/Ag/Entomology/ythfacts/alltr/ythfacts.htm - Games, stories, fun facts, crafts and monthly insect activities.

www.burgepest.com - Pictures and information about insects and other critters

www.kidzone.ws/animals/lifecycle.htm - Explanations of the different insect life cycles with printable worksheets.

www.ent.iastate.edu/zoo/lessonplans/lifecycles.html - Explanations of the different insect life cycles including optional classroom activities

http://insects.tamu.edu/fieldguide/index.html - Overview of the insect orders and detailed explanation of each order.

http://bugguide.net/node/view/15740 - Find images, help with identification, and other information about insects and other arthropods. (Submit a photograph of an arthropod needing identification.)

http://www.bijlmakers.com/entomology/begin.htm - Basic information of the insect world for beginners.

http://www.backyardnature.net/2insect.htm - General information about insects you might find in your own backyard.

http://www.si.edu/Encyclopedia_SI/nmnh/buginfo/start.htm - Articles and information about different insects found in the United States and elsewhere.

http://www.earthlife.net/insects - Interesting and fun facts including a complete insect order key.

http://www.enchantedlearning.com/themes/insects.shtml - Activities, crafts, poems, and songs appropriate for the elementary classroom.

http://www.forestryimages.org/browse/catsubject.cfm?cat=17 - Describes insects that produce galls and other interesting behaviors.

http://www.dnr.state.il.us/education/index.htm - Educational materials, games, and workshops from the Illinois Department of Natural Resources.

http://en.wikipedia.org/wiki/Insects - Online encyclopedia describing insect diversity, body parts, insect roles and behaviors with links to different types of insects.

http://kids.yahoo.com/directory/Science/Nature/LivingThings/Animals/Invertebrates/Arthropods/Insects - Find many links to articles on different kinds of insects.

https://www.pebblego.com - (subscription required) Provides many articles, videos and games about insects.

Materials from Workshop

http://www.ustoy.com - Insect models (product # VL134).

http://www.bioquip.com - Insect collecting and preserving equipment.

http://www.carolina.com - Live insects and insect collecting equipment.

http://www.kidfish.bc.ca/cycle.htm - Four-phase insect life cycle.

http://www.kidfish.bc.ca/cycle2.htm - Three-phase insect life cycle.

Insects at Work in Our World - Next Generation Science Standards

Science (1st Column) and Engineering (2nd Column) Practices

Science Explorations	Asking Questions / Defining Problems		Developing and Using Models		Planning and Carrying Out Investigations		Analyzing and Interpreting Data		Using Math, Information and Computer Technology, and Computational Thinking		Constructing Explanation and Designing Solutions		Engaging in Argument from Evidence		Obtaining, Evaluating and Communicating Information	
Insects and Entomologists	✓		✓	✓	✓				✓						✓	
Insect or Not an Insect	✓		✓		✓		✓		✓		✓		✓		✓	
Insects in the Schoolyard	✓		✓		✓				✓				✓		✓	
Sorting Critters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sorting Common Insects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
Illinois Common Insects	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓
Insect Metamorphosis	✓		✓		✓				✓		✓				✓	
Metamorphosis Live!	✓		✓		✓		✓		✓		✓		✓		✓	
Insect Jobs in Our World	✓	✓	✓	✓	✓				✓	✓	✓	✓			✓	✓
On-Site Field Trip Explorations																
Pollinators on the Prairie	✓		✓		✓		✓		✓				✓		✓	
Life in a Log	✓		✓		✓		✓		✓				✓		✓	

Insects at Work in Our World - Next Generation Science Standards

Science (1st Column) and Engineering (2nd Column) Practices (cont'd)

Science Explorations	Asking Questions / Defining Problems		Developing and Using Models		Planning and Carrying Out Investigations		Analyzing and Interpreting Data		Using Math, Information and Computer Technology, and Computational Thinking		Constructing Explanation and Designing Solutions		Engaging in Argument from Evidence		Obtaining, Evaluating and Communicating Information	
Waders in the Water	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
Other Resources																
Insects and Language Arts			✓						✓						✓	
Insect Research	✓				✓		✓		✓						✓	

Insects at Work in Our World - Next Generation Science Standards							
Crosscutting Concepts							
Science Explorations	Patterns	Cause and Effect	Scale, Proportion and Quantity	Systems and System Models	Energy and Matter	Structure and Function	Stability and Change
Insects and Entomologists	✓		✓	✓		✓	
Insect or Not an Insect	✓		✓	✓		✓	
Insects in the Schoolyard	✓	✓	✓	✓		✓	
Sorting Critters	✓	✓	✓	✓		✓	
Sorting Common Insects	✓		✓	✓		✓	
Illinois Common Insects	✓		✓	✓		✓	
Insect Metamorphosis	✓	✓	✓	✓		✓	✓
Metamorphosis Live!	✓	✓	✓	✓			
Insect Jobs in Our World	✓	✓	✓	✓	✓	✓	✓
On-Site Field Trip Explorations							
Pollinators on the Prairie	✓	✓	✓	✓		✓	✓
Life in a Log	✓	✓	✓	✓	✓	✓	✓

Insects at Work in Our World - Next Generation Science Standards							
Crosscutting Concepts (cont'd)							
Science Explorations	Patterns	Cause and Effect	Scale, Proportion and Quantity	Systems and System Models	Energy and Matter	Structure and Function	Stability and Change
Waders in the Water	✓	✓	✓	✓		✓	✓
Other Resources							
Insects and Language Arts	✓	✓	✓	✓	✓	✓	✓
Insect Research	✓	✓	✓	✓	✓	✓	✓

Insects at Work in Our World - Next Generation Science Standards															
Core Ideas															
Science Explorations	LS1.A Structure and Function	LS1.B Growth and Development of Organisms	LS1.C Organization for Matter and Energy Flow in Organisms	LS1.D Information Processing	LS2.A Interdependent Relationships in Ecosystems	LS2.B Cycles of Matter and Energy Transfer in Ecosystems	LS2.C Ecosystem Dynamics, Functioning, and Resilience	LS2.D Social Interactions and Group Behavior	LS3.A Inheritance of Traits	LS3.B Variation of Traits	LS4.A Evidence of Common Ancestry and Diversity	LS4.B Natural Selection	LS4.C Adaptation	LS4.D Biodiversity and Humans	ETS1.B Developing Possible Solutions
Insects and Entomologists	✓			✓					✓	✓	✓		✓	✓	✓
Insect or Not an Insect	✓								✓	✓	✓		✓	✓	✓
Insects in the Schoolyard	✓				✓		✓		✓	✓	✓		✓	✓	✓
Sorting Critters	✓								✓	✓	✓		✓		✓
Sorting Common Insects	✓								✓	✓	✓		✓		✓
Illinois Common Insects	✓				✓				✓	✓	✓		✓		✓
Insect Metamorphosis	✓	✓	✓		✓	✓			✓	✓	✓		✓		✓
Metamorphosis Live!	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Insect Jobs in Our World	✓		✓	✓	✓	✓	✓	✓		✓			✓	✓	✓
On-Site Field Trip Explorations															
Pollinators on the Prairie	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓
Life in a Log	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

Insects at Work in Our World - Next Generation Science Standards															
Core Ideas (cont'd)															
Science Explorations	LS1.A Structure and Function	LS1.B Growth and Development of Organisms	LS1.C Organization for Matter and Energy Flow in Organisms	LS1.D Information Processing	LS2.A Interdependent Relationships in Ecosystems	LS2.B Cycles of Matter and Energy Transfer in Ecosystems	LS2.C Ecosystem Dynamics, Functioning, and Resilience	LS2.D Social Interactions and Group Behavior	LS3.A Inheritance of Traits	LS3.B Variation of Traits	LS4.A Evidence of Common Ancestry and Diversity	LS4.B Natural Selection	LS4.C Adaptation	LS4.D Biodiversity and Humans	ETS1.B Developing Possible Solutions
Waders in the Water	✓	✓		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓
Other Resources															
Insects and Language Arts	✓	✓	✓	✓	✓	✓				✓			✓	✓	✓
Insect Research	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

Insects at Work in Our World - Common Core

English Language Arts	Reading: Literature				Reading: Informational Text				Reading: Foundational Skills				Writing			Speaking and Listening		Language		
Activities	Key Ideas and Details	Craft and Structure	Integration of Knowledge and Ideas	Range of Reading and Level of Text Complexity	Key Ideas and Details	Craft and Structure	Integration of Knowledge and Ideas	Range of Reading and Level of Text complexity	Print Concepts	Phonological Awareness	Phonics and Word Recognition	Fluency	Text Types and Purposes	Production and Distribution of Writing	Research to Build and Present Knowledge	Comprehension and Collaboration	Presentation of Knowledge and Ideas	Conventions of Standard English	Knowledge of Language	Vocabulary Acquisition and Use
Insects and Entomologists	✓	✓	✓		✓	✓	✓	✓				✓	✓		✓	✓				
Insect or Not an Insect													✓		✓	✓				
Insects in the Schoolyard													✓		✓	✓	✓			
Sorting Critters					✓		✓						✓	✓	✓	✓	✓			
Sorting Common Insects													✓	✓	✓	✓	✓			
Illinois Common Insects													✓	✓	✓	✓	✓			
Insect Metamorphosis					✓		✓								✓	✓	✓			
Metamorphosis Live!																				
Insect Jobs in Our World					✓		✓									✓	✓			
On-Site Field Trip Explorations																				
Pollinators on the Prairie																	✓			
Life in a Log																	✓			

Insects at Work in Our World - Common Core – (cont'd)																						
English Language Arts	**Reading: Literature**				**Reading: Informational Text**				**Reading: Foundational Skills**				**Writing**			**Speaking and Listening**		**Language**		
Activities	Key Ideas and Details	Craft and Structure	Integration of Knowledge and Ideas	Range of Reading and Level of Text Complexity	Key Ideas and Details	Craft and Structure	Integration of Knowledge and Ideas	Range of Reading and Level of Text complexity	Print Concepts	Phonological Awareness	Phonics and Word Recognition	Fluency	Text Types and Purposes	Production and Distribution of Writing	Research to Build and Present Knowledge	Comprehension and Collaboration	Presentation of Knowledge and Ideas	Conventions of Standard English	Knowledge of Language	Vocabulary Acquisition and Use
Waders in the Water																	✓			
Other Resources																				
Insects and Language Arts			✓	✓	✓							✓	✓					✓		✓
Insect Research	✓		✓		✓	✓	✓						✓	✓	✓			✓		✓

Insects at Work in Our World - Common Core

Mathematics	Operations and Algebraic Thinking					Number and Operations in Base Ten			Measurement and Data					Geometry	Mathematical Practices							
Activities	Represent and solve problems involving addition and subtraction.	Understand and apply properties of operations and the relationship between addition and subtraction (1st).	Add and subtract within 20.	Work with addition and subtraction equations (1st).	Work with equal groups of objects to gain foundations for multiplication (2nd).	Extend the counting sequence (1st).	Understand place value.	Use place value understanding and properties of operations to add and subtract.	Measure lengths indirectly and by iterating length units (1st).	Measure and estimate lengths in standard units (2nd).	Tell and write time (1st). Work with time and money (2nd).	Relate addition and subtraction to length (2nd).	Represent and interpret data.	Reason with shapes and their attributes.	Make sense of problems and persevere in solving them.	Reason abstractly and quantitatively.	Construct viable arguments and critique the reasoning of others.	Model with mathematics.	Use appropriate tools strategically.	Attend to precision.	Look for and make use of structure.	Look for and express regularity in repeated reasoning.
Insects and Entomologists	✓		✓						✓	✓						✓		✓				
Insect or Not an Insect														✓		✓						
Insects in the Schoolyard																						
Sorting Critters														✓		✓	✓					
Sorting Common Insects														✓		✓	✓					
Illinois Common Insects														✓		✓						
Insect Metamorphosis																						
Metamorphosis Live!																						
Insect Jobs in Our World																						

Insects at Work in Our World - Common Core (cont'd)

Mathematics	Operations and Algebraic Thinking					Number and Operations in Base Ten			Measurement and Data					Geometry	Mathematical Practices							
Activities	Represent and solve problems involving addition and subtraction.	Understand and apply properties of operations and the relationship between addition and subtraction (1st).	Add and subtract within 20.	Work with addition and subtraction equations (1st).	Work with equal groups of objects to gain foundations for multiplication (2nd).	Extend the counting sequence (1st).	Understand place value.	Use place value understanding and properties of operations to add and subtract.	Measure lengths indirectly and by iterating length units (1st).	Measure and estimate lengths in standard units (2nd).	Tell and write time (1st). Work with time and money (2nd).	Relate addition and subtraction to length (2nd).	Represent and interpret data.	Reason with shapes and their attributes.	Make sense of problems and persevere in solving them.	Reason abstractly and quantitatively.	Construct viable arguments and critique the reasoning of others.	Model with mathematics.	Use appropriate tools strategically.	Attend to precision.	Look for and make use of structure.	Look for and express regularity in repeated reasoning.
On-Site Field Trip Explorations																						
Pollinators in the Prairie			✓		✓								✓	✓					✓			
Life in a Log			✓		✓								✓	✓					✓			
Waders in the Water			✓		✓								✓	✓					✓			
Other Resources																						
Insects and Language Arts												✓		✓								
Insect Research													✓	✓					✓			