Prairie Insects

Grade: 4th Season: Fall Time: 1 ½ hours
Group Size: One class Ratio: 1 adult: 5 students

For the Teacher:

Overview	During an investigation, students examine land insects in the prairie. They generate questions, collect and closely observe prairie insects, and record data about them. They also classify their collected insects and discover their importance in the prairie.
Subjects Covered	Science, Language Arts
MN Science Standards Supported	Helps support three standards. See section "Minnesota Academic Standards in Science"
Skills Used	Investigating, observing, collecting, counting, grouping, matching, classifying, reading, writing, organizing, listening, following directions, teamwork, exploring, questioning, collecting data, analyzing data, forming conclusions, critical thinking, identifying, sketching, examining, discovering, choosing, reading, reflecting, compare and contrast
Performance Objectives	After completing this activity, students will be able to… • Suggest, investigate, and answer questions about prairie insects • Distinguish between insects and other invertebrates • Name two types of insect Orders (such as beetles and flies) • Label the basic parts of an insect (head, thorax, abdomen, 6 legs, 2 antennae, wings, compound eyes) • Provide one reason why insects are important
Vocabulary	Invertebrate, vertebrate, investigate, classify, pollination, food chain

For the PWLC Instructor:

PWLC Theme	The Prairie Pothole Region
Primary EE Message	The prairie pothole region is valuable and in need of restoration and protection.
Sub-message	Wildlife: The prairie pothole region is home to a variety of resident and migratory wildlife.
PWLC EE Objective	• Use scientific methodology to explore the environment (ask questions, hypothesize, collect data, analyze data, form conclusions, make recommendations). • Identify the components and functions of a given ecosystem by observing, counting, and describing the animals and plants in that ecosystem.
Materials	Insect nets, hand lenses, loupes, collecting containers, insect order identification sheets
Location	Any prairie or lawn location at the PWLC and classroom space

Background Information

The purpose of this lesson is to provide students the opportunity to observe, collect, classify, and identify prairie insects through a scientific investigation. The KWHL chart and method often used in reading is applied to science, providing structure to their investigation. The specifics of their investigation are driven by the questions they generate and by the thinking they use for determining their protocol in the field. Putting prairie insects in the hands of students creates an authentic learning opportunity, a

chance to apply what they have learned in the school classroom about insects and other invertebrates or about classification. In addition, through their first-hand experience in the prairie, students witness the ecological role of prairie insects. Insects are of immense ecological value in terms of biodiversity, the food chain, decomposition, pollination, and soil modification.

Insects are important because of the biological **diversity** they provide to the prairie. Several thousand insect species may be found in a single Minnesota prairie community. In North America, hundreds of grasshopper species inhabit the prairie. Minnesota is home to more than 130 grasshopper species. In any single "Gopher State" prairie, 50 or more grasshopper species may be found. Insects are the largest group of grassland plant eaters in numbers and likely mass.

Prairie insects are also important because they play an enormous role in the prairie **food chain**. Insects are meals for other small and medium-sized meat eaters like beetles, ants, spiders, songbirds, American kestrels and other small raptors, and some rodents like the 13-lined ground squirrel. On the flip side, their specialized mouthparts allow them to consume plant life in various ways. For example,

- Aphids and true bugs pierce plants and suck out the juices for a liquid meal.
- Thrips scrape holes in plants to access the liquids inside.
- Bees lap nectar, flies sponge it up, and butterflies and moths sip it through their hollow, siphon tongue.
- The worker caste of harvester ants chew on seeds, leaves, and stems with their powerful jaws. Sawflies, beetles, grasshoppers, and caterpillars feed in a similar fashion.

Many species of prairie bees lay eggs in individual underground nests, placing eggs on small pellets of pollen which is later consumed as these bees develop and grow. Insects, especially grasshoppers and crickets, shape the prairie landscape with their pruning action, creating patchy open areas within it, allowing certain pioneer plant species or those more dependent upon disturbance and daylight to become established. Through their eating behaviors via the food chain, grasshoppers change the prairie landscape and contribute to the diversity of plants found here.

Prairie insects keep nutrients cycling in the system through the food chain and through **decomposition**. Blowflies, ants, carrion beetles, scarab beetles, yellow jackets, and many other species visit freshly dead carcasses to scavenge a meal. Dung beetles consume animal waste, manure which they tear off and roll into a ball then bury underground to eat or lay eggs on. Hatching eggs make a first meal of the manure. A dung beetle can devour its own weight in dung juices in a day. Insect decomposers facilitate efficient and continued movement of nutrients through the prairie.

Although they are tiny animals, prairie insects also modify and **improve soil**. The infinite tunneling action of ants alone, for instance, loosens and mixes prairie soil, bringing nutrients from below the root zone to the top where plants can use them. Dead and dying birds and insects hauled underground by burying beetles contribute nutrients and organic matter to soil. Holes created by female grasshoppers laying eggs invite

water to more easily infiltrate the surface. Perhaps surprisingly, these inconspicuous habits play a major role in soil modification.

Most prairie flowers cannot self-**pollinate**. While grasses rely on the wind to distribute their pollen, most flowers rely on insects to cross-pollinate and produce seed and the next generation of forbs. Lured by a meal of nectar or pollen or other insects, beetles, beeflies, butterflies, moths, wasps, and bees inadvertently carry pollen from one flower to another in their search for food. While many pollinators are generalists and visit a variety of plants, some are specialists. Bees are likely the most important prairie pollinators. Some bees are only found in native prairie as opposed to grasslands in general. Some may be found solely in upland native prairies, sand prairies, or bottomlands. In a different bee example, some bee species match up to certain flower species based on proboscis length matching to the corresponding flower tube length of wild bergamot (long tube), purple coneflower (mid-length), or Culver's root (short). In yet a third bee example, bee species active at different times of the growing season visit certain groups of plants blooming during those same times. Prairie plants and insects depend upon each other for survival. Each team of flowers and insects meets each other's needs and keeps the prairie buzzing and propagating.

According to J. Reese Voshell, Jr., author of A Guide to Freshwater Invertebrates of North America, more than 1 million species of animals inhabit the world. Ninety-five percent of them are invertebrates. Of these invertebrates, about 900,000 insect species have been discovered and described by science. Yet scientists estimate there are an equal number of insects that have not yet been discovered.

Discovering and studying organisms requires **classifying** them: organizing them into groups of similar organisms. Fourth graders visiting the prairie in fall have the opportunity to collect and classify insects.

The main hierarchical categories for organizing living things are: kingdom, phylum, class, subclass, order, family, genus, and species. They are arranged in a nested series from the broadest categories (kingdom) to the most specific (species). A species is defined as organisms that are similar in structure and can successfully produce fertile offspring. As an illustration, here is how the housefly is classified:

Kingdom Animalia (animals)
Phylum Arthropoda (arthropods)
Class Hexapoda (hexapods)
Subclass Insecta (insects)
Order Diptera (true flies)
Family Muscidae (muscid flies)
Genus *Musca*
Species *domestica*

The biology of organisms becomes more uniform the closer to the species level as well as the more challenging to accurately identify. This lesson emphasizes classification of

insects to the order level (highlighted in yellow above), a fair compromise between biological uniformity and identification difficulty. All 26 insect Orders are represented on the prairie. The eight most common insect Orders students collect at the PWLC are:

Order Name	Insect Groups
Odonata	Dragonflies and damselflies
Orthoptera	Grasshoppers, crickets, mantids; dominant on big bluestem prairies
Hemiptera	True bugs such as stink bugs, milkweed bugs, box elder bugs; dominant on big bluestem prairies
Homoptera	Leafhoppers, treehoppers, aphids, scale insects
Coleoptera	Beetles such as fireflies, ladybird beetles, and weevils
Lepidoptera	Butterflies and moths; numerous on big bluestem prairies
Diptera	True flies such as the deer fly, house fly, and blow fly; dominant on big bluestem prairies
Hymenoptera	Bees, wasps, ants, ichneumons

According to the Encyclopedia of Insects, as a group of insects, beetles have the largest number of known species. The Order Coleoptera contains more described species than in any other Order in the animal kingdom, comprising about 25% of all known life-forms. Forty percent of all described insect species are beetles (about 350,000 species). New beetle species are often discovered.

Classification of insects in the field allows students to become more familiar with the prairie. It helps them become more comfortable with our prairie home as an intricate ecosystem and appreciate its diversity, beauty, and ecological integrity.

Teacher Preparation

- Help save paper. Bring your students' science notebooks or journals to record their investigation questions, field data, results, and conclusions. If science notebooks are not available, please inform the PWLC staff that you will need paper and clipboards when booking your date.
- With your students, practice thinking of appropriate questions that can be investigated outdoors. For example, which of these two questions can they best answer today by going outdoors? *How many insects are there in the world?* -- OR-- *How many kinds of insects are in our school yard right now?* Being as specific as possible helps make the questions more realistic. Appropriate questions are key to developing an effective investigation and help develop critical thinking skills.
- We highly recommend conducting one or more of the suggested extensions before your visit in order to integrate this field investigation into the classroom study of animals, insects, life cycles, adaptations, prairie, or other topics. We believe such integration enhances student motivation for learning in other curricular areas. Please see section, "Teacher-Led Extensions/Adaptations/Assessment Ideas."

PWLC Staff Preparation

Organize field materials and scope and select appropriate prairie sites for insect collection and study.

Field Investigation Procedure

1. In a classroom, welcome students, teachers, and chaperones to the Prairie Wetlands Learning Center.
2. Organize students into small groups, each led by a chaperone, and inform chaperones of their role in following through on instructions for students.
3. Next, prepare to go out in the field and collect prairie insects. Distribute clipboards, paper, and pencils to each student or ask them to open their science notebooks.
4. To begin the investigation, start a KWHL chart and ask students what they know about prairie insects. Ask their teacher to record their responses on the white board or poster paper. Give them plenty of time to think and respond, guiding where needed, but not answering for them. At this point, and from their perspective, there are no right or wrong answers in asking them what they know. Even if the information they give is incorrect, resist the temptation to correct them at this point if possible. Doing so will allow for open sharing and for you to gauge where they may need help with this topic during their visit. However, you may prompt students for specifics by asking them such things as, "What do you know about insects? The adaptations of insects? What kinds live in the prairie? What do you know about the life cycle of prairie insects? Where do insects live in the prairie?"
5. Next, ask students what they wonder about prairie insects? What questions do they have about them? They should think about questions that can be answered by going outside today and exploring. Each question should also be recorded in the column next to what they know. Again, give them ample time to think and respond. Try not to provide them with questions to investigate. Coming up with their own questions will give them more ownership in the investigation. If necessary, prompt them with questions like: "Is there something you would like to find out today about prairie insects? What do you wonder about prairie insect adaptations?"
6. Select four questions to investigate. For the third KWHL column, ask students how we will find the answer to each question. Will we stay on the trails or go off-trail? What kinds of rules or tools will we need to bring and use? Match the tools with the appropriate questions on the chart, creating the third column, "H," how we will find out.
7. On the white board, demonstrate how to organize their data sheet with a title, date, location, and four titled quadrants, one for each question. Incorporate their suggestions if possible.
8. Review rules for the trail. Remember to mention that we will not be picking flowers or intentionally breaking plants.
9. Line up in small groups at the door. Remind students that they are scientists conducting a real scientific investigation just like adult scientists do. Scientists

are quiet and respectful outdoors. They have a purpose in the field to complete their mission (in this case, collecting insects).

10. Travel to the area you will collect insects and give space boundaries. In their small groups, students can collect and identify their insects to the Order and record their data. They should release the insects when finished or as needed. Move from group to group to assist and check that chaperones and students are correctly identifying their insects and to answer questions.
11. Return indoors to the four questions and answer them together as a class. Write them down with the questions or add a last column (the L in KWHL, Learned). Ask students to write a one-sentence discovery they made about the prairie or about insects. If needed, prompt them with sentence starters like, "I never knew that …" or "Today I discovered that …" Ask a few students to read their sentences to share their discoveries with the class. Ask students to share any new questions they have about prairie insects. Are prairie insects important? Why or why not?
12. Explain that adult scientists conduct investigations this same way, starting with what they already know about something, what questions they wish to investigate, how they will investigate them, field work, results, discoveries, conclusions, new questions, recommendations, etc. Ultimately they share their results with other scientists and people so we can all learn from them about our world. Challenge them as scientists to go home and find at least one other person they can share today's discoveries with in person, via email, on the phone, in a letter, etc. They should briefly and quietly share who they will share their discovery with a classmate.
13. Thank students for their help with the investigation and the chaperones for their leadership. Thank everyone for helping to collect the seeds and restore the prairie. Invite them to come back again to visit.

Weather Alternative

Field investigations take place rain or shine. Everyone should dress appropriately for the weather. In the event of unsafe weather (lightning, high winds) or pouring rain, everyone must come indoors. PWLC staff make every effort to make your travel worthwhile despite the weather and prepare indoor, age-appropriate plans. PWLC staff welcome teacher input into these plans. Some possible alternatives might include:

- Go outside for a very short amount of time, even if only under the deck to search for prairie insects near the building.
- Tour the exhibit area and watch prairie wetlands videos with the objective of keeping track of which insects are observed. Which Orders do they belong to? How many of the eight common Orders were observed?
- Set up insect stations such as displays of preserved specimens, Insects and Spiders card game, pre-collected live specimens to observe and sketch, and insect books. Rotate students among the stations.

Teacher-Led Extensions/Adaptations/Assessment Ideas

- To maximize outdoor classroom time at the PWLC, teachers may conduct steps

3 through 5 in the section “Field Investigation Procedure” at school. Upon arrival at the PWLC, teachers may provide PWLC staff with a written list of what students know and wonder for quick review before completing the remaining steps.

- To help students understand the concept of classification, ask each student to remove one shoe. Place all of these single shoes into a pile. Practice classification by organizing them into groups based upon similar characteristics. Students can suggest what those characteristics might be (such as color, size, shape, design, function, etc.). Then they should write down their groupings and randomly select one shoe. By observing the shoe and studying their groupings, can they place it into the correct group? Try the same process with a few more shoes and revise the groupings if needed.
- Diagram an insect and it external body parts (head, thorax, abdomen, six legs, two antenna, wings, compound eyes)
- Ask an art teacher to instruct your students in basic sketching techniques for insects. Practice using schoolyard insects. A great resource is Draw and Color Insects by Walter Foster and Diana Fisher. Good insect choices relevant for the prairie and included in the book are cricket, stink bug, treehopper, damselfly, ant, leaf beetle, acanthosomatid bug, and katydid.
- Introduce the common insect Orders to your students (as described in the Background section, above or as depicted in the student materials, below). You may use the scientific names of the Orders (such as Hymenoptera) or the common names (ants, bees, wasps) or both.
- Collect, observe, and release insects in your school yard to compare/contrast to those students collect at the PWLC. Which insect Orders are represented? Are they the same ones as found in the prairie? Why or why not?
- Keep a classroom insect phenology notebook through the school year. From this log, make a timeline using register tape to hang in the hallway or classroom. When is the last insect observed in fall? Are any insects active in winter? When do hibernating insects begin to emerge? Which kind is first? How many Orders of insects are observed through the year?
- Maintain and record behavior observations of an ant farm in your classroom.
- In September, keep a chrysalis or cocoon in a container and watch the butterfly or moth emerge. Record daily observations and use that data to draw conclusions about them. Release the adult moth or butterfly outdoors while the weather is still warm.
- Use insects to create a prairie food chain or food web or food pyramid.

Minnesota Academic Standards in Science

This lesson helps support the following state standards.

Strand I. HISTORY AND NATURE OF SCIENCE

Substrand A. Scientific World View

Standard: Understand how science is used to investigate interactions between people and the natural world

Benchmark 1. Explore the uses and effects of science in our

interaction with the natural world

Benchmark 2. Discuss the responsible use of science

Benchmark 3. Recognize the impact of scientific and technological activities on the natural world

Substrand B. Scientific Inquiry

Standard: Participate in a controlled scientific investigation

Benchmark 1. Recognize when comparisons might not be fair because some conditions are not kept the same

Benchmark 2. Collect, organize, analyze and present data from a controlled experiment

Benchmark 3. Recognize that evidence and logic are necessary to support scientific understandings

Strand IV. LIFE SCIENCE

Substrand B. Diversity of Organisms

Standard: Know that living things can be sorted into groups in many ways according to their varied characteristics, structures and behaviors

Benchmark 1. Classify plants and animals according to their physical characteristics

Benchmark 2. Learn that the characteristics used for grouping depend on the purpose of the grouping

References and Resources

Books and Web Sites for Adults

- A Guide to Common Freshwater Invertebrates of North America by J. Reese Voshell, Jr.
- Encyclopedia of Insects by James K. Liebherr and Joseph V. McHugh in Resh, V. H. & R. T. Cardé (editors)
- How Should We Live Together? U.S. Fish and Wildlife Service, Minnesota Valley National Wildlife Refuge curriculum
- Insectigations by Cindy Blobaum
- Kaufman Field Guide to Insects of North America by Eric R. Eaton and Kenn Kaufman
- Minnesota's Natural Heritage, an Ecological Perspective by John R. Tester
- Prairie, a Natural History by Candace Savage
- Ranger Rick's NatureScope, Incredible Insects by National Wildlife Federation
- An Introduction to Ants of the Tallgrass Prairie, http://www.npwrc.usgs.gov/resource/insects/ants/index.htm
- Bugguide, http://bugguide.net/node/view/15740
- Grasshoppers: Their Biology, Identification, and Management, http://www.sidney.ars.usda.gov/grasshopper
- Insect World Records, http://ufbir.ifas.ufl.edu/

Books and Web Sites for Children

- Bugs! By Christopher Nicholas
- Flies Taste with their Feet, Weird Facts About Insects by Melvin and Gilda

Berger

- Golden Guide, Insects by Herbert S. Zim, PhD and Clarence Cottam, PhD
- Hey Little Ant by Phillip and Hannah Hoose
- Peterson First Guides, Butterflies and Moths by Paul A. Opler
- The Bug Book by Dr. Hugh Danks
- The Everything Kids' Bugs Book by Kathi Wagner
- Thinking About Ants by Barbara Brenner
- What's Inside? Insects by Dorling Kindersley, Inc.
- Bugbios, insect Orders http://www.insects.org/entophiles/index.html
- North American Insects and Spiders/Orders, http://cirrusimage.com/index.htm
- What's That Bug?, www.whatsthatbug.com

Credits

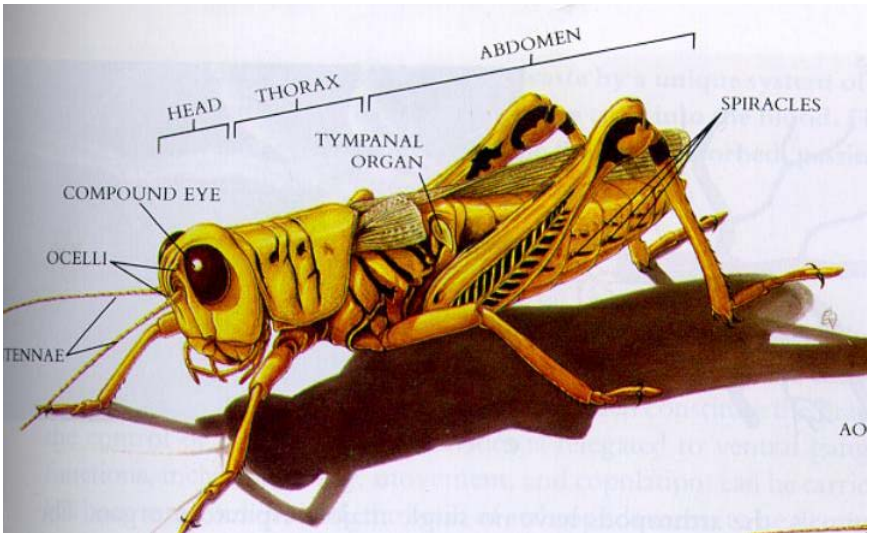
This field investigation was developed and written by Prairie Wetlands Learning Center Staff, U.S. Fish and Wildlife Service. (Thanks to Prairie Science Class naturalist Tia Thysell for reviewing this lesson plan.) Thanks to the following teachers for reviewing this lesson plan: Kathy Kolle, Cleveland Elementary, Fergus Falls; Chip McAllister and Mona Davis, Prairie Science Class, Fergus Falls; and Jean Larrivy, Fergus Falls School District. Thank you to Moriya Rufer, Lakes Program Coordinator, RMB Environmental Laboratories, Detroit Lakes, for reviewing this lesson also.

Student materials follow.

Common Insect Orders

Insects Have

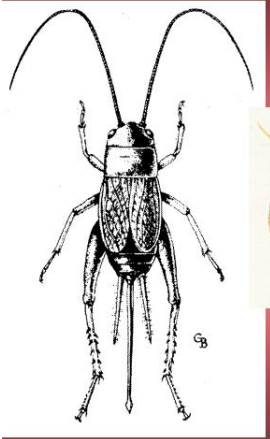
- **Head**
- **Thorax**
- **Abdomen**
- **6 legs**
- **2 antennae**
- **Usually some wings**
- **Compound eyes**



Order Odonata: dragonflies & damselflies

Suborder Anisoptera--dragonflies
--hind wings broader at base
--wings nearly horizontal at rest
Aeshnidae--darners
Libellulidae--skimmers

Suborder Zygoptera--damselflies
--front / hind wings similar in shape
--wings held together above body
Calopterygidae--broad-winged damselflies
Coenagrionidae--narrow-winged damselflies



Orthoptera (or-THOP-ter-ra)
ortho = straight *ptera* = wings
grasshoppers, crickets, katydids

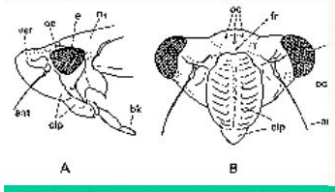
- 1st pair wings elongate and **leathery**
- **Filiform antennae**
- Well developed ***cerci***
- **Long ovipositor** in females

More Insect Orders on the Back

Hemiptera
(hem-MIP-ter-ra)
hemi = half
true bugs

- front wing **thickened and leathery at base, membranous at tip: *hemelytron,*** wings at rest held **flat over body**
- **piercing-sucking mouthparts**: **beak** arising from **front of head**
- many have triangle shaped ***scutellum***
- antennae ≤5 segments

Homoptera
(ho-MOP-ter-ra)
homo = alike
cicadas, hoppers, aphids, scales



- **Piercing-sucking mouthparts:** short **beak** arising **under head**
- Most: 2 pairs of **membranous** wings held **roof-like over body**

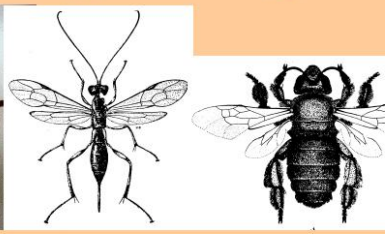
Lepidoptera (leh-pih-DOP-ter-ra)
lepido = scale
butterflies, skippers, moths

- Wings covered with **scales** (come off on our fingers as "dust")
- Sucking mouthparts: coiled **proboscis**
- **Large compound eyes**

Coleoptera
(ko-lee-OP-ter-ra)
coleo = sheath
beetles

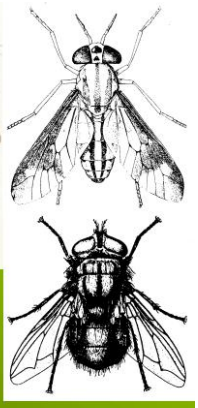
- Front wings modified into hardened or leathery ***elytra,*** meeting in a straight line down the back and covering membranous hind wings
- **Chewing mouthparts**
- Very large and diverse order--40% of known insects!

Hymenoptera
(hi-men-NOP-ter-ra)
hymeno = god of marriage
bees, ants, wasps



- Four **membranous** wings; hind wings smaller, have a row of hooks (= ***hamuli***) for joining to front wings
- Chewing mouthparts, modified in many for lapping
- Ovipositor developed; sometimes modified into stinger
- Hard bodied, active insects, with well-developed compound eyes and often **"thread-waisted"**

Diptera
(DIP-ter-ra)
di = two



true flies

- **1 pair** of functional, **membranous** wings; hind wings reduced to ***halteres***
- **Large compound eyes**, **sucking mouthparts** (piercing or sponging)
- Antennae arising between eyes, often short, 3-segmented (***exceptions)***