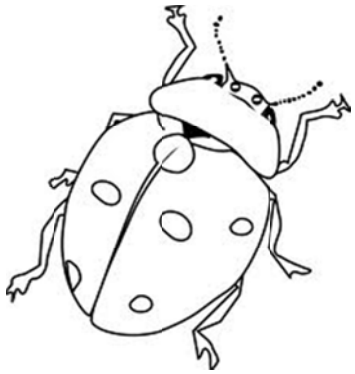
Montana Natural History Center

Insect Investigations Curriculum



Insect Investigations

Nature Discovery Trunk Contents List

-1 MNHC curriculum binder
-Insect Investigations Student Journal (printed for copying, in binder)
-1 Large Plastic Tote with Lid

Articles, Books & Pamphlets:
-A Butterfly is Patient
-The Beetle Book
-Step Gently Out
- A Golden Guide: Insects
- A Golden Guide: Butterflies and Moths (5)
- Peterson First Guides: Insects
- Kaufman: Field Guide to Insects of North America (2)
- Kaufman: Field Guide to Butterflies of North America
-Montana Pollinator Education Project: Pollinator Field Guide (5 on o-ring)
- Buzz into Action: Insect Curriculum Guide, NSTA
-Insectigations: 40 Hands on Activities to Explore the Insect World

Insect Collection Materials:
- Pop-up 'Port A Bug' house
- White 5 x7 plastic collection trays (5)
- Magnification boxes (30)
-Two way bug viewers (5)
-Hand Trowel (3)

Insect Life Cycle Displays in Resin:
-Butterfly Life Cycle
-Ladybird Beetle Life Cycle
-Grasshopper Life Cycle

Additional Equipment:
-5 insect "eye" tubes
- Large Magnetic Insect set (14 pieces)
-Insect Stamp Collection (18 pieces)

Photographs (laminated and labeled in plastic (?) folders:
-Insect Order ID Cards (10)
-Insect Life Cycles sequence cards (5)
-Forest Floor (4)

Lesson 1: What is an Insect?

Purpose*:* Students will investigate the characteristics that define all insects and learn to identify several common insect Orders. Students will practice insect collection activities and observe living insects.

Scientific Process Skills*:* Observation: Organization of living organisms based on their physical form; recognization of similarities and differences amongst life forms. Communication : Use drawings and visual displays to clarify ideas and observations.

Learning Objectives:

- Students will learn the common characteristics of all insects.
- Student will be able to explain how scientific classification is used to group insects.
- Students will be able to identify several common insect orders.

Time: 45 minutes to 1 hour

Location: Classroom and exploration in an outdoor space (i.e. playground, sports field, nearby natural area.)

Materials provided in trunk:

- Insect investigations Journal template (.pdf)
- Insect body parts magnets
- Insect magnets for five insect Orders
    - *Lepidoptera*: butterfly, moth
    - *Coleoptera:* beetles
    - *Hymenoptera*: bee, wasp, ant
    - *Orthoptera*: grasshopper
    - *Odonata*: dragon fly
- Insect order ID cards (10)
- Two way bug viewers
- Magnification boxes
- Field guides: Insects, Butterflies

Materials provided by the teacher:

- Student copies of journal template
- White board or large piece of paper
- Writing pencils, colored pencils
- Large jars or Tupperware for collection*
- Insect nets (optional)
- White collection sheet

Background Information:
Biologists have classified all living things into groups based on their physical and genetic similarities. Why is this important? **Classification** (the arrangement of organisms and information into groups) makes things easy to find, identify, talk about, and study.

Insects belong to the **Kingdom** Animalia. The other Kingdoms include the plants (Plantae), fungi (Fungi), and four that organize the many, many microorganisms on earth!

Insects belong to the **Phylum** Arthropoda, which means 'without a backbone.' Insect skeletons are on the outside of the body; they have no spine! Humans belong to the phylum Cordata, which means 'with a backbone'.

Insects belong to the **Class** Insecta. Everything in this class will have all the insect characteristics covered in the section: Identifying Insects Basics.

There are many **Orders** of insects. Fifteen are commonly encounter in Montana. During this lesson your students will learn to recognize five of these based on their wings.

There are over 201 individual insect species listed online in Montana*. Identification to **Genus** and **Species** often requires the collection and preservation of multiple life-stages and individuals of an insect. These samples must be carefully examined under high-powered magnification. Insect identification to species is so challenging that professional research scientists often send their species to other scientists for confirmation.

It's not necessary for your students to go through the entire classification system used by scientists for this activity but the 7 levels are included here for your reference: Kingdom, Phylum, Class, Order, Family, *Genus, species*. These levels can be remembers with the silly mnemonic device: Kids Prefer Cheese Over Fried Spinach.
* http://www.insectidentification.org/insects-by-state.asp?thisState=Montana

Identifying Insects Basics:
Insects and bugs: Are they the same? The word 'bug' casually references all creepy crawly life forms. Learning about insects begins with understanding that insect is a scientific grouping. We can prove something is or isn't an insect with careful observation and identification. All insects have the following characteristics:

Exoskeleton – insects have a lightweight but strong exterior skeleton. The exoskeleton gives muscles a place to attach, and protects internal organs. To grow, many insects molt, or shed their exoskeleton.

Segmented body parts- insects have three body regions:

- The head functions mainly for food and sensory intake. Insect mouthparts have evolved for chewing (beetles, caterpillars), piercing sucking (aphids), sponging (flies), and siphoning (moths, cutting, biting flies). Eyes and antennae are also on the head.
- The thorax provides structural support for the legs (three pair) and, if present, for one or two pairs of wings.
- The abdomen functions in digestion and reproduction.

Segmented legs- All insects have three pairs of jointed or segmented legs. Insect legs show amazing adaptations for jumping, grasping, digging, and swimming.

Compound eyes- In contrast with our eyes, insect eyes are immoveable and unable to focus. A compound eye, consisting of two to 30,000 lenses, is primarily intended to detect the motion of predator or prey. Some, but not all, insects can see in color. Which ones? Typically insects that feed on nectar from flowers!

Antennae- Insect antennae are movable sensory organs located are between the eyes on the forehead. All insects have paired and moveable antennae. In most species their primary function is smelling!

Spiracles for breathing- Spiracles are openings in the insect exoskeleton that lead to the respiratory systems. Air passes through the spiracles into a system of branched tubes (trachea) that end in the tissues where oxygen is needed.

Identification of 5 common insect Orders:
The scientific name for each insect order we will explore holds important clues for identification. Often, order names reference physical features of insect wings that define each grouping. Your students will learn to recognize the following orders:

Leptidoptera- "scale wings;" the butterflies and moths; named for the tiny shingle-like structures that cover their wings. Most students will recognize that these scales rub off if you handle a Leptidoptera. While they can still fly if they lose their scales, they will lose their color, which helps them attract a mate.

Coleoptera- "hard wings;" the beetles; named for their two hard, shell-like forewings. Identify them by the straight-line running down their thorax where these wings come together. Beetles also have two membranous hind wings that are scrunched up under the hard forewings and unfold for flight. Imagine how a lady "bug" lifts its hard forewings and then

flaps the soft hind wings to take off. Cool fact: beetles are the most diverse insect order. There are 6X as many beetles as all the mammals, fish, birds, amphibians and reptiles combined!

Hymenoptera- "membrane wing;" the bees and ants; named for their clear glass-like wings, this group will have four wings as adults, with the front pair being longer than the back pair. However, some adult hymenoptera, like ants, are wingless! Hymenoptera can also be identified by a unique and oddly narrow "waist "between the thorax and the abdomen (wasp waist). Hymenoptera is the second most diverse group of insects.

Odonata- "toothed jaw;" dragonflies and damselflies; named for their toothed jaws. Odonates are actually a carnivorous insect! They **do not** carry venom or poison to sting. The two physical features that best identify this order are extremely large compound eyes and a long slender abdomen. Odonates are aquatic or semi aquatic in their early life stages. This helps explain why we most often find adults flying and perched near water!

Orthoptera- "straight wings;" grasshoppers and crickets; named for their straight forewings. You can tell a grasshopper by its accordion style, often colorful, hind wings that are unfolded in flight or identify them by their large hinds legs, adapted for jumping.

Procedure: The engagement portion of this lesson can take place in the classroom prior to going outside. Curriculum referenced: Visiting Naturalist in Schools, Montana Natural History Center

Part One: *ENGAGE* (10 min)

1. Ask the students begin their insect investigation by drawing their favorite or least favorite insect in one quadrant on page #2 of their journal. Give students a short defined time period, just a minute or two, to draw. When time is up, encourage a few students to share why they chose their insect and their experience with that particular type of insect.

2. Challenge students to explain the difference between a bug and an insect. Insects are a scientific classification and can be identified by specific characteristics. Have students brainstorm as many characteristics of insects they can on their own. If brainstorming insect characteristics is difficult use the large insect magnets and prompt- *"These are all insects. What characteristics do they share? What parts do they all have?"*

Part Two: *EXPLORE (*10 min*)*

1. Using the background information you feel comfortable discussing, complete the class definition of an insect so in includes that insects have three body parts, 6 segmented legs, and an exoskeleton instead of a back bone. Use the magnetic body parts included in the trunk to illustrate the characteristics.

2. Have students check their first drawing against their new knowledge. Did they REALLY draw an insect? How many of them drew six legs? Are those legs segmented?

3. Divide students into small groups (2-4) students and distribute a laminated insect Order card or large magnet to each group.

4. Have students draw and describe their insect in a quadrant of their journal page. Students should focus on drawing and labeling insects with three body parts, antennae, and six segmented legs. How many wings do they need to draw on each insect? Don't forget to label this drawing with the Order!

Part Three: *EXPLAIN: (*10 min*)*

1. Have each group identify their insect Order's unique features, connecting these to the scientific order name.

2. Have each group share the defining characteristics of their Order, along with the scientific name with the whole class.

3. Using the background information you feel comfortable discussing, explore common these common Orders with students. Which ones do they see often? Where? Explore different names they may use for these insects.

Part Four: *ELABORATE* (15-20 min) *Field Collection*

1. After the classification lab, take students outside. Demonstrate the use of the collection tools you have available. Show students how to use the bug viewer to contain collected insects.

2. Set boundaries for collection activities and then turn students loose to collect insects and other bugs in the magnifying box and bughouse. Use collection sheet to help collection activities

3. As students bring insects and other invertebrates back, encourage them to identify and draw/describe their favorites in the remaining journal space on page #2.

4. Apply careful risk management to these activity- students may have allergies to insect stings; allergies can be known or unknown.

5. Challenge students to use the field guides to identify new insect orders they encountered during collection (i.e. *Diptera*- flies).

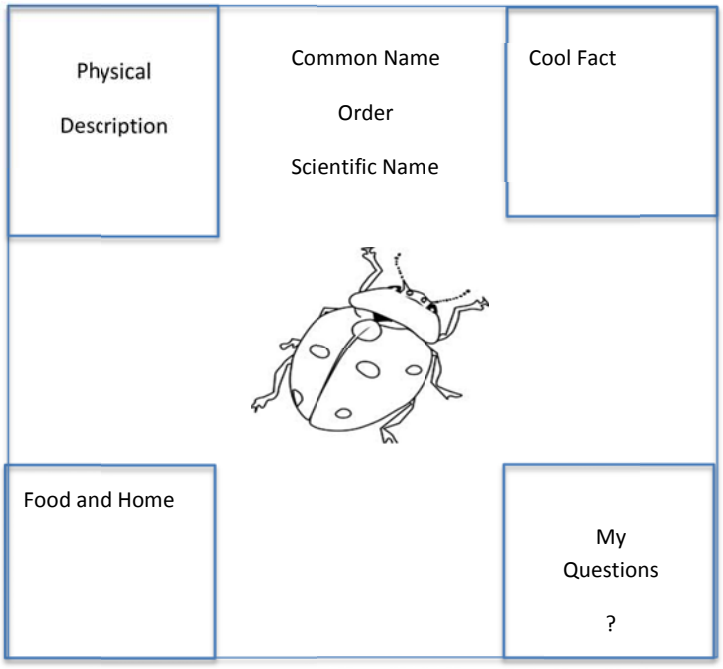
6. As time (or interest) is winding down, gather the students back together and use their discoveries to follow up on your lesson on insect orders.

Part Four Option: *ELABORATE* (15-20 min) *Field Guide*
Students benefit from the opportunity to engage with living insects in their natural environment. If access to a natural area requires a separate time period from the classroom portion of the lesson, the field collection activity easily stands alone. If the weather is cold or wet, try moving rocks and logs to look for insects. However, is an outdoor exploration is not possible – try the following activity with the trunk field guides!

1. Distribute a selection of insect field guides to each group. Give students 5 minutes to explore the different guides.

2. Have students share their observations and discoveries with a partner. Focus this sharing on the unique physical forms of the insects. *"How would you recognize this insect if you found it?"* After sharing, each group should choose one insect to create a large poster like the one below. Challenge students to identify the Order their insect belongs to.

3. End by having students present their posters in class.



Part Five: *EVALUATE* (5 min)

1. Using the collected specimens to quiz students on which are insects and which are not. Once you have separated out the insects, can you classify a few to Order based on what they learned today? Don't worry about the ones you can't recognize (there will likely be many.)

2. Allow 15 minutes for students to present their insects to the rest of the class. The presentations can be conducted in a manner that meets the needs of your class.

3. Journals can be evaluated for student exploration of the characteristics of an insect and their ability to identify and communicate defining characteristics of insects.

4. Student materials can be assessed based on a scale of poor, fair, good, and excellent.

Extension Ideas:

- Insect order BINGO! Using the bingo card template and provided woodblock bug stamps have students create their own bingo card. Use the provided randomly generate bingo call card. The first student to fill up a row on their Bingo card can be the next caller!
- Research different types of invertebrates and create a T-chart of similarities and differences with insects
- *Insectagations* curriculum: Twist and Insect activity, p.27
- Explore 15 common insect orders of Montana at http://nhguide.dbs.umt.edu/index.php?c=insects&m=browse

Key terms:

Classification- The organization of objects and organisms based on their similarities.
Head- The anterior most of the three main body parts of an insect. The head has a pair of antennae and the compound eyes.
Thorax- One of the three main body parts of an insect. The thorax is the middle segment, behind the head and before the abdomen. Legs and wings (if present) are attached to the thorax. The thorax contains the locomotive musculature and is also well supplied with spiracles and trachea to supply the muscles with oxygen.
Abdomen- The abdomen is one of the three main body segments of insects. It is also the name given to one of the two main body parts of spiders. The abdomen is the posterior most of the segments. In most insects clear segmentation can be seen in the abdomen. The abdomen contains the heart, reproductive organs, mid-gut and other digestive organs.
Compound eye- An eye consisting of an numerous small visual units, as found in insects and crustaceans.
Antennae- long, slender, segmented appendages on the heads of insects**.** Antennae are primarily used for smelling and feeling.

Lesson 2: Insect Life Cycles

Purpose*:* Students will work in small groups to sequence the natural life cycles of ladybugs, butterflies, grasshoppers**,** dragonflies, and beetles from egg to adult.

Scientific Process Skills*:* Observation: Organization of living organisms based on their physical form, recognization of similarities and differences between life forms. Communication : Use drawings and visual displays to clarify ideas and observations.

Time: 30 to 45 minutes

Location: classroom

Materials provided in trunk:

- Insect Investigations Journal template (.pdf)
- Insect life cycle cards and vocabulary markers
    - Orthoptera: grasshopper
    - Lepidoptera: butterfly/moth
    - Hymenoptera: bee
    - Odonata: dragonfly
    - Coleoptera: beetle
- Insect life cycle examples
    - Grasshopper
    - Dragonfly
    - Butterfly

Materials provided by the teacher:

- Whiteboard/butcher paper

Learning Objectives:

- Observe the changes that occur during the growth and development of insects.
- Understand life cycle details vary from one organism to another.
- Understand that changes occur in insect requirements of foods and habitats during their life cycle.
- Develop hypothesis for the cause of variations between the types of metamorphosis and ask questions to extend their knowledge.

Background Information:

A **life cycle** is a period involving one generation of an organism, or the timeline in which an insect is born/hatched- grows to maturity -and reproduces**. Metamorphosis** is a part of the insect life cycle and refers to the way an insect's body will develop, grow, and change during its life. There are two types of insect metamorphosis**: complete** and **gradual**. Metamorphosis in the physical insect body is usually (but not always) accompanied by changes in habitat or behavior. Many insects spend the largest portion of their life as young immature insects,

while humans and most mammals spend the majority of their life as mature adults. Adult insects may only mate, lay eggs, and die soon afterwards.

Complete metamorphosis

Most insects go through a four staged life cycle called 'complete metamorphosis.' Examples include the ladybug, housefly, and butterfly.

1. **Egg** - A female insects lays eggs. Sometimes eggs are in a group and protected by a covering or case.
2. **Larva** - Larvae hatch from the eggs but do not look like adult insects. The larvae of butterflies and moths are caterpillars. Larvae grow quickly and have to molt their exoskeletons. Sometimes, these stages of growth in larvae are called "instars."
3. **Pupa** –This juvenile insect form is known for making protective coverings around themselves as they change into their adult form. Pupas do not eat. This life stage can take a few days, or in some cases months.
4. **Adult** - After a period of time, the pupa completes its physical transformation, and exits the cocoon or larval body as an adult.

Gradual- or incomplete metamorphosis

A small proportion of insect species go through a 'gradual' or 'incomplete' metamorphosis. Though less common, some of our best-known insects do this, including the mayfly, cicada, grasshopper, aphid, and cockroach.

1. **Egg** - A female insect lays eggs.
2. **Nymph** - The eggs hatch into nymphs. Nymphs looks like small adults, but usually don't have wings. They eat, grow, and molt their exoskeletons as they grow. As this occurs, they gradually begin to look more and more like the adult.
3. **Adult** - Once the nymph has grown to an adult size, they stop molting. Generally adulthood is the only time in an insect's life when it has wings.

Procedure:

Part One: *ENGAGE* (5-10 min)

1. Divide kids into of 3-5 groups. Give each group a space and an insect life cycle folder. Make sure at least one of each type of metamorphosis is distributed.

2. Give students 5-10 minutes to arrange the cards in sequence- creating a lifecycle timeline for and individual insect.

3. Ask students *"Which stages of insect development might correspond to the child, teenage, and adult stages in the human life cycle?"*

Part Two: *EXPLORE* (5-10 min)

1. Point out that insects develop body parts (like lungs and wings) and change shape as they mature. This process is called metamorphosis.

2. Have students examine and compare the life stages. "*Does it always have six legs?"*

"Three body parts?" "Is this a pest or a friend? Why?"

3. Encourage students to rearrange their cards as needed. On page #4 have students generate a list of questions they have about their organism's life cycle

Part Three: *EXPLAIN (15 min)*

1. Give each group 5 minutes to present their timeline to the rest of the class. As a large group insert the vocabulary cards to each life cycle sequence. Insert background information on the individual life stages: egg, larvae, pupa, nymph, adult.

2. Highlight the characteristics of incomplete metamorphosis, complete metamorphosis. Ask students to describe the differences and similarities in each insect's life cycle. *"Do all of our insects go through the same set of changes?" "How are the life cycles of the organisms similar? How are they different from one another?"* Butterflies, honey bees, and ladybugs all have a complete metamorphosis. Grasshoppers and dragonflies have an incomplete metamorphosis.

3. Explain to students that insect metamorphosis is usually accompanied by a change in the survival requirements and habits of an insect. Ask students *"Where do the larval insects live? Where do the adults live? Do they eat different things than the adults?"* Highlight the physical changes that occur in order for an insect to move to a different part of the habitat and begin eating different things. Identification of insects to species often requires the observation of several life stages.

Part Four: *ELABORATE* (5 min)

1. Consider the questions students recorded in their journals. Students might wonder where different insect life stages might live or how long these changes take.

2. Ask students why insects grow and change through metamorphosis, and why there are different kinds of metamorphosis (gradual and complete).

3. Give students five minutes to explore one of these questions in the space provided on page #4 of their journal.

Part Five: *EVALUATE*

- After each timeline is presented quiz students on the life cycle presented by their peers.
- Using the presentation as a tool, students should be able to identify the main stages of development within each life cycle. In their journal on page #5, students should further their understanding of life cycles through questioning.
- Observe students as they work in groups to identify the life stages of their insect, monitored their ability to work together to complete the activity.

Extensions:

- Watch this video segment that explores the developmental process of metamorphosis : *http://www.pbslearningmedia.org/resource/tdc02.sci.life.cyc.metamorph/metamorphosis-change-of-plans/*
- Read *A Butterfly is Patient* by Dianna Hutts Aston
- Create a science station in your classroom with the insect life cycles in resin from the trunk. Collect student observations, drawings, and questions from the station on a large piece of butcher paper at the station.

Key terms:

Life cycle - A period of time between birth and successful maturity of an insect.
Metamorphosis - A process which drastically changes the physical appearance (its form or structure) of an insect/organism between birth and adulthood.

Complete metamorphosis- An insect life cycle which includes four stages: egg, larva, pupae, and adult,

Incomplete metamorphosis- An insect life cycle which includes three stages: egg, nymph, and adult. Nymphs look like small adults and keep this form as they continue to grow and shed their exoskeleton until they reach adult size.

Molt - To shed an outer covering that is replaced by a new one.

Larva – A newly hatched form of some insects (i.e. caterpillar or grub). Larvae are wingless and spend their time eating before developing into a pupa.

Pupa - The non-feeding stage in which a larval insect goes through a complete change inside a hard case. Most students are familiar with the pupal coverings of moths (cocoon) and butterflies (chrysalis.)

Nymph - The immature form of insects in a gradual metamorphosis. Nymphs look like small adults without fully developed wings. Nymphs develop into adults without going through a pupal stage. Examples are dragonflies and grasshoppers.

Adult- The mature stage of life. Adult insects do not grow or molt but they are able to reproduce offspring. Adults insects have three pairs of legs, a body segmented into a head, thorax, and abdomen, and usually two pairs of wings.

Lesson 3: Insect habitats: Outdoor exploration

Purpose*:* With this outdoor scavenger hunt students explore a variety of insect habitats and the survey the resources in each. The scavenger hunt focuses on identifying unique components of a habitat and drawing connections between organisms and their environment. Classroom discussion can extend this concept to a comparison of habitats and the number and type of organisms found there.

Scientific Process Skills*:* Observation: Organization of habitats based on their biotic and abiotic features. Comparison: students will create comparisons between the resources shaping insect habitats. Communication: Use drawings and visual displays to clarify ideas and observations.

Time: 45 minutes to 1 hour

Location: Classroom and an outdoor space with as much vegetation diversity as possible (i.e. playground, sports field, nearby natural area.)

Materials provided in trunk:

- Insect Investigations Journal template (.pdf)
- Magnification boxes
- Two way bug viewers
- Insect I.D. Books (5)
- Field Guides: Insects, Butterflies

Materials provided by the teacher:

- Student copies of Insect Investigation Journal
- Writing pencils, colored pencils
- Large jars, plastic containers for collection
- Clipboards, Pen or pencil

Learning Objectives:

- Students will practice identifying the key components of a habitat: space, food, water, and shelter; students will describe the living (biotic) and non-living (abiotic) parts of a microhabitat.
- Students will make detailed observations and practice drawing connections and comparisons between the abiotic and biotic factors of different microhabitats.
- Students gain an understanding of the interdependence of all life forms and identify major causes of change to insect habitats.

Background Information:

A **habitat** is the arrangement of living (biotic) and non-living (abiotic) things, which together supply an organism's basic requirements for survival. Every living thing has specific habitat requirements, based on the type of food, shelter and space it needs. **Microhabitat** is a term for the conditions and resources found in the immediate vicinity of a plant or animal.

Like living organisms, we classify habitats to easily recognize and describe them. Habitats are classified by their physical characteristics, climate, and types of vegetation. Descriptions of habitats can be very loose, such as a mountain, plain, dessert and aquatic habitats, or very exact. Scientists often define habitats in carefully measured terms: i.e. a mixed age conifer stand, ponderosa pine/ blue bunch wheatgrass, or remnant Palouse prairie habitat.

In all habitats, important interactions are constantly taking place among both **biotic (living)** and **abiotic (living)** things. By carefully examining individual habitats and the organisms that live there, we begin to see the connections that hold together our terrestrial ecosystems. Scientists spend a lot of time surveying habitats to determine the resources available for the organisms that live there.

Insect Habitats

Insects are the most successful animal life on earth and can be found in virtually all terrestrial habitats. In Montana, there are over 200 species of insects – compared to only one species of human! In your schoolyard there are most likely many species of insects using the distinct microhabitats found there.

Plants provide many great microhabitats for insects. Besides serving as food for herbivorous insects, plants also provide important shelter and places for insects to mate and reproduce. You can find insects on just about every plant part imaginable! Some live entirely within the leaves of plants, others nest in stems or branches, under bark, or in the trunk itself. Honeybees need flowers and build nests in tree cavities and under edges of plants to provide their own shelter. Trees and flowering plants are the most common habitats for butterflies.

Other species of insects are commonly found in the soil, in plant or animal tissues, in carrion or dung, or hiding under stones or leaves during the day. At night, they emerge to search for food.

Your schoolyard is full of microhabitats for insects! For example, your schoolyard environment might offer microhabitats under leaves or wood chips, in a grassy lawn or bush, or inside sidewalk crack! These microhabitats are each unique and support insect populations adapted to that type of environment. As you explore your schoolyard microhabitats you may encounter pollinators, decomposers, and leaf eaters; you might see are beetles, snails, slugs, ants, grasshoppers, earwigs and spiders.

Your students will be amazed to find their outdoor area contains many microhabitat. Fine scale surveys encourage detailed observation.

Procedure: (The engagement portion of this lesson can take place in the classroom, prior to going to your outside area.)

Part One: *ENGAGE* (10 min)

1. In class prior to going outside: Ask students "*What do all humans need to survive?***"**

2. Guide class to generate list. Focus on the four basic needs of living things: food, water, shelter/ protection, and the space for these things to exist. Possible prompts: *"Could you live squished in a room with all your friends, forever?"; "Where do you get food when you are hungry? Water?"; "Where do you hide from heavy cold rain?"* Students may give other answers, which you can put with the four major categories.

3. Ask students to pull out their journals. On page#5 under the heading "My Habitat" students will spend 5 minutes creating a map of their habitat. This could be their house, neighborhood, or larger area. Encourage kids to limit their habitat to the places they visit frequently.

Part Two: *EXPLORE* (10-15 min)

1. Head outside. As a class revisit the habitat needs generated in classroom and ask *"Which of these do insects require?"*

2. As a group, identify examples of the space, food, shelter, and water available for insects in this place.

3. Inform students that they will be going on a scavenger hunt within a defined boundary with a partner. They should look up, down, under rocks or logs, on the underside of leaves, inside flowers, in the grass, and underneath piles of leaves they find!

4. In pairs have students search a defined area to complete the scavenger hunt on page #6.

Part Three: *EXPLAIN (*5 min*)*

1. Scavenger Hunt- What does this all mean? As you discuss the observations made during the scavenger hunt discuss the following concepts:

Who's in this Micro Habitat Scavenger Hunt!

- Find three safe place an insect might rest. Draw a picture of that spot or describe it with words. Is it a living shelter? **Biotic and abiotic factors**
- Find two non-living things and draw or write how they could be important for insects. **Ecosystem**
- Can you find insect food in this spot? List what kinds? **Habitat, Herbivore, Predator, Scavenger**
- Listen for an insect in your area. What do you hear?

- Write down three living organisms that you think use this habitat. **Micro-habitat vs habitat.** "*Does anyone know what the word "Micro" means?" Micro = small. "Does a micro habitat fill all survival requirements for an insect's entire life?"; "How do you think the number and types of insects found in a habitat change over time. "*
- Can you find a place where humans might have contributed something to this habitat? What does it look, feel, and smell like? How might it affect an insect? **Ecosystem**
- Draw what this place might look like in 20 yrs.

2. Explore microhabitats using an example from forest habitats in Montana. Ponderosa pine forests are a common habitat type in Montana. Although these woodland environments are habitats on their own, there are many smaller microhabitats contained within each forest. For example, a single dead ponderosa pine tree will create important microhabitat for insects. Which types? Insects who use rotting wood for food and shelter, like bark beetles and ants!

Part Four: *ELABORATE* (10 min)

1. Invite students to explore again and compare two microhabitats. They should record any insects found there and list the resources available in each. A quick map sketch of the microhabitat could also be included.

2. Students should create a list of similarities and differences between micro habitats

3. Create a collage of their schoolyard habitats. On a rough sketch of your outdoor area students will put together the microhabitats they found using the flowers, grass, etc., whatever they need to communicate the microhabitats they found. Next, have students add drawings of the insects they saw!

Part Five: *EVALUATE*

1. Observe students as they participate in the scavenger hunt to assess their ability to make detailed observations, investigate questions of interest and to communicate their observations to peers.

2. Allot 5 minutes for students to present their observations to the rest of the class. The presentations can be conducted in a manner that meets the needs of your class.

3. Journals can be evaluated for a basic understanding of biotic and abiotic factors, student exploration of survival requirements, and the ability to identify resources in an ecosystem.

4. Student materials can be assessed based on a scale of poor, fair, good, and excellent.

Extensions:

- Provide students with the prompt "*Nature will bear the closest inspection. She invites us to lay our eye level with her smallest leaf, and take an insect view of its plain." — Henry David Thoreau.* Students can create a piece of artwork, a poem, or list of places to look for insects using this prompt as inspiration.
- Explore a habitat in your schoolyard and survey and photograph the insects within that habitat. Have students chose one insect, research its habitats, and then report their findings in a poster, drawing or digital story.

Key terms:

Ecosystem- A system formed by the interactions of organisms with their environment
Habitat- The space where a living organism can secure its essential needs.
Microhabitat - the conditions and resources found in the immediate vicinity of a plant or animal.
Abiotic factors- Non-living chemical or physical factors in an environment. These factors include: Soil, Water, Air, Temperature, and Sunlight (SWATS).
Biotic factors- A living thing that affects an ecosystem. Biotic factors include plants and animals.
Herbivore- An animal that depends on plants for food
Scavenger- An animal that depends on dead things for food
Predator- An animals that depends of catching live prey

Lesson 4: Comparing Lepidoptera: Butterflies, moths and skippers

Purpose*:* Students will learn to differentiate between sub groupings in the Lepidoptera order. Students will use a Venn diagram to compare and contrast moths, butterflies and skippers.

Scientific Process Skills*:* Observation: Organization of living organisms based on their physical form. Communication : Use drawings and visual displays to clarify ideas and observations.

Time: 20-30 minutes

Location: classroom

Materials provided in trunk:

- Insect Investigations Journal template (.pdf)
- Insect magnets for:
  - Lepidoptera: butterfly, moth
- Magnifying boxes
- Golden Guide: Butterflies and Moths

Materials provided by the teacher:

- Student copies of Insect Investigations Journal
- White board or large piece of paper
- Writing pencils, colored pencils

Learning Objectives:

- Students will make detailed observations about the physical differences between moths, butterflies, and skippers.
- Students will practice organizing information with visual device.
- Students will create comparisons between lifeforms.

Background Information:

Moth vs Butterflies vs Skippers

Venn Diagrams are excellent tools for organizing the similarities and differences among organisms. Physical differences that students might observe while exploring distinct groupings within the order Lepidoptera include differences in body shape, antennae, behavior, and wings. Moths and skippers are recognized as having thick and fuzzy bodies, while butterflies are more slender and smooth. Butterfly antennae are long and thin and always have a thick "club" at the ends; skipper antennae are similar but display a curved end. Moth antennae vary in shape from straight to feathered but always lack the knobs we find on butterflies and skippers. Butterfly wings are often brightly colored on one side; moth wings are mostly muted colors; and skippers come in a broad range of colors and patterns.

Behavioral comparisons may include that butterflies and skippers are active during the day while moths are generally active at night. Wing position while resting can also identify between these suborders. Butterflies and skippers usually rest with their wings held erect; help straight up from the body. Moths rest with their wings folded flat against their body. Moths and butterflies can also be distinguished in the pupae form. Moths pupate in cocoons- constructed silk cases that cover the changing insect. A butterfly chrysalis is actually a hard skin that the butterfly molts to become and adult!

Ecological Role

Lepidoptera suborders play several important ecological roles. Many are of economic interest by virtue of their role as pollinators or pest species.

- Adult Lepidoptera pollinate many native and crop producing plants. Flowers attract the adults with sugar-rich nectar.
- Lepidoptera larvae browse certain parts of plants, including seeds and flowers, and can become problematic pests in agriculture. In many species females produce from 200 to 600 eggs; others may produce 30,000 eggs in one day. Caterpillars hatching from these eggs can cause damage to large quantities of crops.
- Many predators and parasitoids depend on both adult and larval Lepidoptera for food.

Procedure: ***** *adapted from the Buzz into Action, p.29*

Part One: *ENGAGE* (5 min)

1. Use large insect magnets to remind students that butterflies and moths are insects. Ask "*How many legs do you think a butterfly or moth has? (six) Why?*" All Lepidoptera are insects and insects have six legs! "*What other body parts do you think butterflies and moths have?*" Head, thorax, abdomen, antennae, and an exoskeleton!

2. Recall that these two types of insects are grouped together in the order Lepidoptera, Ask "*What are some ways that butterflies and moths are alike?* (They have scales on their wings; they lay eggs; their life cycles have the same stages; some look alike.)

3. You may choose to create a T-chart to help graphically organize student answers. List characteristics of one organism on one side of the chart and the characteristics of another insect on the other side of the chart.

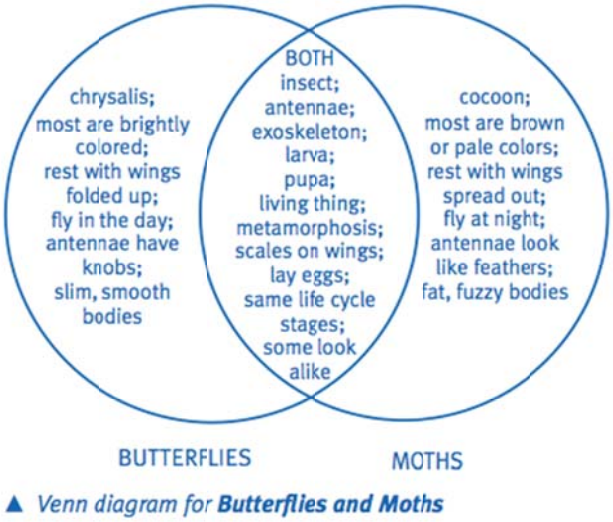
Part Two: *EXPLORE* (10 min)

1. Divide students into small group (2-4) to explore the field guides from the trunk. Assign each group one suborder of Lepidoptera- moths, butterflies or skippers- and have students draw and describe a specimen that might be found in Montana. Use the range map included with each description to determine which species are suitable.

2. Students create a list of noteworthy characteristics of their insect on page #13 of their journal.

3. Pair groups together. Engage students in a descriptive conversation about the similarities and difference between their species. Groups should take turn sharing their noteworthy and identifying characteristics verbally then placing them in the appropriate Venn space on page #14.

4. After creating their comparison, ask students *"What new noteworthy characteristics did you notice about?" "Did anything change your opinion about which sort of Lepidoptera your group had?"*



▲ *Venn diagram for* ***Butterflies and Moths***

*This also can be done with a three-circle Venn diagram

Part Three: *EXPLAIN (*5 min*)*

1. Ask groups to share their Venn diagrams. Supplement their observations with as much of the background information as is appropriate.

2. Identification beyond order is complicated and often requires the observation of multiple life stages of an insect. Discuss differences between the cocoon of a moth and the chrysalis of a butterfly. The finer scale our groupings become, the more details needed to recognize members of any group.

3. Over 20 species of butterflies in the U.S. are endangered. They are losing habitat. Pesticides and chemicals can kill them. Butterflies have been widely used by ecologists

as model organisms to study the impact of habitat loss and fragmentation, and climate change.

Part Four: *ELABORATE*

1. Revisit the field guides to explore different sub groupings of Lepidoptera.

2. Challenge groups to determine how to distinguish between other sub groupings (swallowtails, fritillaries, sulfurs and whites).

3. What type of information might help us distinguish between larval Lepidopterans?

Part Five: *EVALUATE*

1. Observe students groups for their ability to recognize and record fine scale details. Observe groups as they construct the Venn diagrams for their ability to recognize and communicate similarities and differences.

2. Nature journals can be evaluated for student exploration of the characteristics of a butterflies and moths and their ability to identify and accurately describe the differences similarities between subgroupings of the Lepidoptera order.

3. Student materials can be assessed based on a scale of poor, fair, good, and excellent.

Extensions:

- Check out our favorite YouTube celebrity, Emily Graslie on The Brain Scoop, as she explores the differences between moths and butterflies.
  https://curiosity.com/video/moths-vs-butterflies-thebrainscoop/?utm_source=facebook&utm_medium=social&utm_campaign=20150127fbmothbutterfly
- Read: *A Butterfly is Patient*, Dianna Hutts Aston.
- Have students research Lepidoptera order! This gregarious Order is full of interesting and amazing species!
  - ❖ The largest moth in the world - the atlas moth - has a wingspan of some 12 inches; the smallest - the pygmy moth - has a wingspan of about one tenth of an inch.
  - ❖ The largest butterfly - the goliath birdwing - has a wingspan of about 11 inches; the smallest - the pygmy blue - has a wingspan of about 1/4 of an inch.
  - ❖ Delicate as it may seem, the monarch butterfly holds the record for insect travel, with some populations east of the Rocky Mountains migrating as much as 2500 miles, from southern Canada to central Mexico, in the fall of the year.
  - ❖ Some butterfly species' caterpillars live among ants in a complementary relationship known as "mutualism." The caterpillars produce a sweet liquid that the

ants love to gather and eat, and the ants drive away predators that would otherwise gather and eat the caterpillars.

- Create a dichotomous key to guide identification of moths and butterflies. A dichotomous key uses a series of two option descriptions to narrow down the possible organism, rock, or other object you are attempting to identify. Visit http://www.insectidentification.org/winged-insect-key.asp for an easy example.
- http://en.wikibooks.org/wiki/Dichotomous_Key/Lepidoptera has a more advanced key for Lepidoptera. Students may struggle using this; however, it is useful in illustrating the level of detail required for identification within orders.

Key terms:

Suborder/ family - An intermediate grouping of organisms within and Order or Family.
Venn Diagram- A visual organizer used to illustrate similarities and differences.
Cocoon- A soft casing of silk or paper made by moths to protect caterpillars as they turn into adults.
Chrysalis- A hard case of external skin that protects a butterfly while it is turning into an adult

Lesson 5: Discovering Decomposers

Purpose*:* In this lesson children discover some of the small creatures that inhabit the soil community, from the overlying leaf litter to the first active layers of soil. Students will explore a nutrient cycle in their environment and diagram the insects that help it happen.

Scientific Process Skills*:*
Observe and classify organisms as producers, consumers, decomposers, predator and prey based on their relationships and interactions with other organisms in their ecosystem. Investigate the action of different decomposers and compare their role in an ecosystem with that of producers and consumers.

Time: 45 minutes to 1 hour

Location: classroom, extension to outdoor space (i.e. playground, sports field, nearby natural area)

Materials provided in trunk:
- Insect Investigations Journal template (.pdf)
- Two way bug viewers
- Magnifying boxes
- Field Guides: Insects
- 5′ x 7′ collection trays (5)
- Trowels

Materials provided by the teacher:
- Student copies of Insect Investigations Journal
- White board or large piece of paper
- Writing pencils, colored pencils
- Large jars, Tupperware for collection

Learning Objectives:
- Students gain an understanding of the role of decomposing insects in the food chain and the role of decomposers and scavengers in recycling organic matter.
- Students gain an understanding that plants and animals depend on each other.
- Students identify habitats which support scavengers and learn that soils are full of life and activity.

Background Information:
Nutrient Cycling
All living things need nutrients to live. Producer organisms take their nutrients from the soil. Consumer organisms get their nutrients from the plants and/or other animals they eat. When something living, a producer or consumer dies, it is actually recycled! **Decomposers** are there to eat the nutrient rich leftovers and **detritus**. Decomposers add protein, vitamins, and

minerals back into the soil. Plants use these nutrients to grow, then get eaten or die, and the cycle continues!

Scavengers in the Soil

Insects adapted to live in the soil are essential because they help recycle dead **organic matter**, plant and animal residues. Once dead organic matter hits the ground- **scavenger** insects, such as flies, beetles, termites, and ants, break it apart into smaller parts. Many species of scavengers prefer certain types of decaying matter, so the species we find on the forest floor may be quite different from those found decomposing a dead body. Within the ranks of decomposer insects scientists who study bugs- or **entomologists** – recognize several major groups:

- those that feed on dead animals (carrion),
- those that feed on dead plant material (leaf litter),
- and those that feed on the excrement of other animals.

Carrion feeders include many sorts of beetles, fly larvae (maggots), wasps, ants, and others. Insects adapted scavenge dead material are an essential part of the biosphere because they help recycle dead organic matter

Soil and wood-dwelling species shred leaves or chew tunnels in woody tissues. They accelerate decay by increasing the amount of organic material exposed for decomposition. These species are largely responsible for creating a layer of dark, organic material called **humus** that often covers the soil.

Procedure:

Part One: *ENGAGE* (15 min)

1. Prior to going outside, show students a picture of the forest floor, a decomposing log, a pile of leaves

2. Ask students to pull out their journal and visit page #15. Under the heading "What I know about this place?" students create a list of words describing the picture. Gather students' ideas on the whiteboard or large paper.

3. Next, students come up with several questions about what lives in this environment. *"Do they think there will be insects here?" "What kinds?"* Have students write their questions on page # 15 of their journal under the heading "What do I want to know about this place?" Add examples to whiteboard or tablet pf paper. Inform students that they will be going outside to investigate the sorts of life living on and in the earth beneath their feet!

Part Two: *EXPLORE* (15 min)

1. Take students outside in the schoolyard or a local park and divide them into pairs. Designate an area for students to search. Before turning students free to explore, demonstrate how to use a hand trowel, examine a shovel samples carefully and

slowly in the white tray, then replace the dirt. Remember to replace material as found, so that microhabitats there remain for animals to use. A rock, log, or leaf pile acts like the roof on a house and creates a stable home for soil insects!

2. Give student pairs 10 minutes to carefully search the school grounds. They should use the hand trowel to overturn a small patch of soil, wood chips, and loose leaf litter, and the white collection trays to examine these samples more carefully. Encourage the turning over of rocks, break apart decaying wood, and sort through plant litter.

3. Watch closely for small living things such as worms, grubs, snails, insects, spiders.

4. Place found organisms in the magnifying box. Have the students observe the insect for a few moments –enough time to create a detailed drawing of what they noticed (color, shape, wings, other features) and to describe the location they found it, and what they think it was doing.

5. After 10 minutes gather students together in the outside space.

Part Three: *EXPLAIN (*10 min*)*

1. Review the questions that the class came up with prior to their search. Discuss the observations made during the exploration. Are the students able to answer any question they generated in the beginning?

2. Talk about the animals you found in your soil sample. Some of these small critters aid in the decomposition of leaves and dead animal matter by eating it and moving it around. Some of them actually live in the soil as predators, like spiders and millipedes that hunt other soil living creatures. There are complete food chains that exist only in the soil.

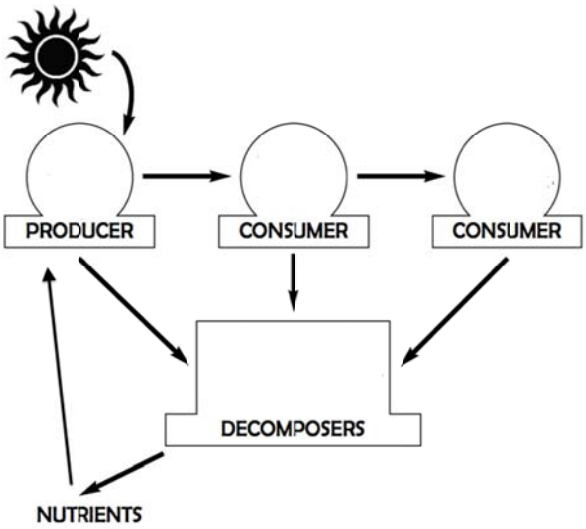
3. Decomposers and scavenger insects that live on the ground play an important role in recycling nutrients and creating productive healthy soils for plants (producers) and animals (consumers) to use. What do you think would happen if there were no scavengers and decomposers on earth?

4. This process leads to the creation of new soil. Decomposition also returns nutrients to the soil. People often think of worms, insects, spiders and other small animals as bad or disgusting, but in nature all things have a place and an important job.

Part Four: *ELABORATE*: (5 min)

1. Allow student pairs 5-10 minutes to explore the area again. Their goal is to complete the energy flow chart on page # 16 of the journal. Make a list/ draw of living things that might be in each box.

2. Invite students to pick one question from the list of class questions to study further through observation and nature journaling.



Part Five: *EVALUATE*

1. Observe students to assess their ability to identify the role of scavengers and decomposers in nature.
2. Nature journals can be evaluated for student exploration of the recycling of organic nutrients and their ability to locate scavengers and decomposition in their outdoor ecosystem.
3. Observation student participation in group explanation time for their ability to investigate questions of interest and to communicate their observations to peers.
4. Student materials can be assessed based on a scale of poor, fair, good, and excellent.

Extensions:

- Explore the importance of the forest floor and its inhabitants by watching the short video: https://vimeo.com/25547255. Have students keep count of the different organisms that play a part in the decomposition process the see in the video.
- Connect Science to Literature. Create insect poetry madness and create acrostics poems about soil creatures they found.
- Create decomposition experiments. Compare the decomposition process of variety substances, or explore what happens with and without the presence of scavenger insects, sunlight, or something else your students hypothesize affects decomposition.
- Create connections! Provide students with nonfiction reading / thinking passages from about decomposers and scavengers.

Key terms:

Nutrients - The nutritional parts of foods that living things uses to survive and grow. This includes the minerals in the soils that plants need to live and grow.
Nutrient cycle- The movement of this essential nutrition through an ecosystem; from the soil into plants (producers), to the animals (consumers), and ultimately back into the soils through decomposition.
Decomposer - Organisms that help break apart dead things and return nutrients to the soil
Scavenger- A decomposer who helps breaks dead things up by eating and digesting them.
Entomologist - A scientist who studies insects.
Detritus- Waste or debris of any kind.
Organic Matter- Plants and animal, dead plants and animals, and the nutrients that have come from decomposed plants and animals.
Humus- A dark-colored organic detritus which forms as plant and animal matter decays. A final product of decomposition. Plant and animals matters are no distinguished and nutrients available for producers (plants).

Lesson 6: Create a school yard insect habitat!

Purpose: Students act as wildlife biologists and restoration ecologists as they design and build a small-scale habitat improvement project. This lesson is a designed as a service learning project.

Scientific Process Skills*:* Observation: Organization of an insect habitat based on its biotic and abiotic features. Prediction: Use of prior knowledge to figure out what will happen in the future. Communication: Use graphs and/or visual displays to clarify ideas and observations.

Time: 2 hrs. Creating your schoolyard insect habitat can take 45 minutes to 1 hour. In the following day(s) students return to their habitat to survey the organisms who have moved in. Surveying requires between 30 and 45 minutes. Your habitat can be revisited and surveyed multiple times until nature, or the class, disassembles it.

Location: This lesson takes place in an outside setting. Check with your school administrator and maintenance staff prior to determine a safe and suitable area to build your habitat.

Materials provided in trunk:

- Insect investigations Journal Template (.pdf)
- Field Guides: Insects, Butterflies
- Two way bug viewers
- Magnification boxes

Materials provided by the teacher/students:

- Outdoor space, approximately 1m x 1m
- Variety of natural materials to construct habitat
- Shallow dish and water for puddles

Learning Objectives:

- Students directly consider how the conditions of their environment might limit what kinds of living things can survive.
- Students apply their understanding of how insects satisfy their needs to the process of designing improvements to insect habitats.
- Students explore how people help maintain and increase biodiversity in their local environment.
- Service Learning: Students understand a need and make a meaningful contribution.

Background Information[LH1]**:**
The survival of insects, animals, and plants relies on the health of their habitat. Today, more than 900 types of plants and animals in North America have been designated as endangered; the vast majority of species on the verge of extinction are insects! Thousands of insects are estimated to have disappeared already! Clearing land for new **development**- the building of new houses, highways, shopping centers and parks - is a leading cause of habitat loss. To

conserve the amazing diversity of living things and prevent the extinction of more species, people must work together to protect and restore insect habitats.

Student Service Learning (SSL).

This insect investigations lesson is designed to fit the three phases of a Service Learning project.

1. Preparation: Students will prepare to make a meaningful contribution by identifying and understanding a need.
2. Action: Students make the contribution to the need. The identified need is addressed through at least one of three ways:
    - Direct Action—you are face-to-face with the recipients of your service
    - Indirect Action—students have no direct contact with the service recipients
    - Advocacy Action—students work to raise awareness or create change
3. Reflection: Students consider the benefits of their service to the community, as well as, what character traits have been strengthened, what skills have been gained, what careers have been explored, and what sense of community they have developed.

Creating Habitats

Providing a variety of habitat elements will attract a diversity of insect life to your schoolyard. Here are few brief suggestions for providing food, water, cover and places for insect life.

Brush Piles: *Brush piles provide food, cover and space for insects.* They can be built by piling up sticks and woody detritus from your area. Look for flycatchers and dragonflies perched on the tips of brush pile branches hunting- or "hawking"- for flying insects!

Rock Piles: *Rock piles provide food, cover and shelter for insects.* Pile rocks and stones from baseball to football size or larger. Be sure to leave large and small spaces between the stones so animals can get in and out. Consider exposure to sunlight when creating your rock pile. A rock warmed up by the sun will stay warm and provide important warmth for cold blooded insects at night.

Logs: *Rotting logs are habitat for many insects.* They provide homes and food!

Meadows: *Meadows attract butterflies and a host of other insects.* Look for an unused section of lawn and allow it to grow tall. Check with your school maintenance staff about letting a small portion of the grounds go unmowed for a short while!

Composting: *Compost piles provide food and habitat for micro-organisms, worms and insects.* Designate an area that will hold vegetable and fruit scraps, leaves, yard and garden clippings. Turn the compost pile into itself often. Look for decomposing insects as you turn your compost

Mud-Puddles: *Many insect species, including many exciting pollinators, need mud puddles to obtain nutrients and water.* In a flower pot saucer or other shallow container, add sand,

compost or rich soil, and water to create a slurry mix. A flat rock placed within the saucer provides a convenient spot for butterflies to land and rest as they take up water, minerals and nutrients.

Procedure:

Part One: *ENGAGE* (outside or in your classroom) (20 min)

1. Ask students to recall their earlier hunt of microhabitats. *"What were the key components of insect habitats (food, water, shelter, space)?" "Do we remember any insects that we found?" "What resources did we think they were using?" "Which resources were easiest to find in our microhabitats?" "What evidence of people did we find? Was it helpful influence or harmful?"*

2. Game option: Invite students partake in a habitat game in which they will imagine themselves as an insect.
    - In order to survive, the insect must collect food, find water, and find a place to stay for shelter.
    - Distribute strips of various colors of paper, (with each color representing an element of habitat) around the room.
    - The color strips are coded as follows
        - Red = shelter
        - Green = food
        - Blue = water
        - Brown = space
    - In order to survive, each student 'insect ' must collect 1 red slip , 3 green slips, 2 blue strips, and 1 brown strip within 30 seconds of the instructor telling the students 'Go!'
    - Student 'insects' who do not collect the needed amount of food, shelter, water, and space do not survive. These students can help redistribute paper slips between rounds.
    - At different intervals, the teacher should simulate the effects of human development on the resources available in the habitat.
    - This activity can take as long as the teacher feels necessary and as long as the children are interested and learning.

3. Explain to students that they will try to create an insect habitat the supplies the elements required by insects for survival. Then, we will come back and survey it to see what types of insects use it!

Part Two: *EXPLORE* (25 min)

1. Prior to this lesson identify an area where it is okay for students to create a habitat, and get the okay from your building manager to gather natural materials and create your habitat improvement.

2. Go outside. As a group, spend 2 minutes searching the area for insects. Keep track of this baseline information! Next, brainstorm materials they observe in this place that could provide food, water, and shelter for insects.

3. Deliver appropriate rules for the collection of natural materials: only take 1 if there are more than 3, nothing thicker than your wrist, check with teacher!

4. Have students spread out and collect a variety of materials. You may wish to supplement your natural area with materials to create mud puddles, or larger logs, rocks, other materials not available nearby.

5. After about 10 minutes, or as students begin to get lose focus, have the class return to your area with items and sit in a large circle. Use the materials gathered and the background information on Creating Habitats to assemble a new habitat structure.

6. Like building a house, you may want to start by placing foundation materials, like sticks, stones, and dead leaves for the basement. Loosely stack large branches and logs cabin style for framing and shelter. Cover the top of this base with smaller materials. Add food and water sources last.

Part Three: *EXPLAIN (*10-15 min*)*

1. Challenge students to identify the four components of a good habitat in their structure? Can they find examples of identify the biotic/ abiotic materials. Students can sketch the completed habitat in their journals on page #17.

2. Remind students of the need our habitat structure is contributing too. *"Why is it important to create insect habitats?"* All of us can play a part in creating or destroying the habitats used by insects. Insect habitats are easy to create and add to your environment.

3. It is important to measure the impact of our efforts. Explain to students that they will return to the habitat to see what organisms have moved in. You can explain the survey process at this point.

Part Four: *ELABORATE* (30-45 min)

1. Revisit your habitat 1-2 days after its creation to survey your habitat and see what has moved in.

2. Divide students into teams of three to four students. In each group assign the following jobs.
   - Data recorder: Responsible for keeping a master copy of all collected information on their data sheet.

- Insect counter (1 or 2): Responsible for finding organisms, identifying them to the best of their abilities (insect is an acceptable identifier), and determining the type of material the organism is found on.
- Insect collectors (2): Responsible for collecting as many of the found insects as possible, and returning them to the data recorder.

3. It may be worthwhile to have one group model this survey as other watch. Begin with insect counter(s) carefully surveying the habitat for insects. If necessary, the counter can move various components of your habitat, but encourage students keep the structure together for future visits and to replace the micro habitats they have created.

4. Insect collector(s) can closely follow the counter(s) with magnifying boxes and insect jars. As they collect as many of the found insects as possible they return them to the data takers area for observation later.

5. Data recorders count the number of species seen, heard, or found on page #18.

6. Explore the following prompts to increase student learning. *"Why do you think these insects decided to use our habitat? Where do you think they came from? Where will they go when our habitat falls down? What improvements could we make to our habitat?" "Did each group find the same kinds?"* If there were multiple types found- *"What does that tell us about this habitat?"* If only a few types were found - *"What does that tell us?"*

7. This survey can be repeated multiple times. Data recorded can be compared to your pre-construction survey (*Explore*: step 2) to measure effectiveness of your improvements, used to graph the number of bugs found over time or number of different bug orders found, or to answer other questions your students came up with!

Part Five: *EVALUATE*

1. Have students explain why they think they found the organisms they did in their habitat. The explanations students give will indicate if students understand the importance habitat, food, and shelter have for survival, their retentions of insect adaptation concepts. Discussion should also indicate the use of desired critical thinking and thought processing patterns.

2. Have students answer the following questions in their notebooks to evaluate the service learning component:
   - **What** did you do?
   - **What** need did your service address?
   - **Who** benefitted from your service?
   - **What** did you learn about yourself?

- **How** was this experience connected to something you learned in a class at school?

3. Student materials can be assessed based on a scale of poor, fair, good, and excellent.

Extensions:

- Incorporate a variety of data collection methods into surveying your habitat.
  - **Photo points**: Establish a photo point by hammering a wooden post into the corner of a plot on your habitat. Mark each site with an identifying name to help catalogue photos. Make notes and keep them with the photos. Consider recording an audio clip to attach to the photo.
  - **Single spot observations**: Similar to a photo point, students identify and return regularly to their own individual spots on the schoolyard to record their observations. Student "single-spots" should be at least 10 feet apart from each other. The more often they do this exercise the richer their observations become.
  - **Transects:** Use hula-hoops or other fixed shapes. Survey and record plant and insect data inside our plot or at a regular interval along a line.

- Develop a testable question to investigate with your structure. For example *"Do some types insects prefer our habitat compared to others. Which habitat features attract the most organisms?"* Use your survey data create a bar graph comparing the number of organisms found.
- Explore the artwork of Christopher Marley and encourage a discussion about how to educate people about critical insect habitats. "*Why might these pictures make people pay more attention to insect habitats?" "How would you help someone realize the importance of insect habitat?"*
- Bring attention and recognitions to insect habitats in your school community! Certify your school yard insect habitat with the National Wildlife Federations Certified Wildlife Habitat Program.