

4-H Natural Resources Curriculum

How Does The Environment in Kentucky Affect The Insects (and Related Arthropods) That Live There?

The goal of this portion of the curriculum is to introduce students to insects and to understand how insect biology and diversity are influenced by environmental factors such as water, soil, and vegetation.

I. How do insects compare with closely related organisms?

a. Ants & Uncles

Objectives: Youth compare insects with other arthropods

Source: 4-H Cooperative Curriculum System Publications

Entomology I, "Creepy Crawlies," p26

Grade Level: any

Materials: clear container to catch and observe insects and their relatives

Setting: outdoor

Time: 1-2 hrs

Core Content Connections:

SC-E-3.1.1 Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).

SC-E-3.1.3 Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

b. Interview a Spider

Objectives: Youth learn that insects and spiders are “wildlife”

Source: *Project WILD*, page 14

Grade Level: any

Materials: research materials (notebooks, etc.)

Setting: classroom

Time: 2 hrs

Core Content Connections:

SC-E-3.1.1 Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).

Assessment: Student is given an insect or insect relative and explains to his peers why the creature is or isn't an insect, discussing characteristics such as: number of legs, number of body parts, presence or absence of antennae, etc.

II. What are the parts of an insect?

a. Big Bugs, Small Bugs

Objectives: Youth learn basic insect anatomy

Source: 4-H Cooperative Curriculum System Publications
Entomology I, "Creepy Crawlies," p6

Grade Level: Any

Materials: pencils

Setting: indoor

Time: 30 minutes

Core Content Connections:

SC-E-3.1.1 Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).

SC-E-3.1.3 Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

b. Insect Cut-Ups

Objectives: Youth learn basic insect anatomy

Source: 4-H Cooperative Curriculum System Publications
Entomology I, "Creepy Crawlies," p12

Grade Level: Any

Materials: pictures of insects, paper, pencils, markers, clear tape

Setting: indoor

Time: 1 hr

Core Content Connections:

SC-E-3.1.1 Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).

SC-E-3.1.3 Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

Background information: This activity complements Big Bugs, Small Bugs

c. Big Mouth Bugs

Objectives: Youth are introduced to insect mouthpart diversity

Source: 4-H Cooperative Curriculum System Publications
Entomology I, "Creepy Crawlies," p8

Grade Level: Any

Materials: pencils

Setting: indoor

Time: 30 minutes

Core Content Connections:

SC-E-3.1.1 Things in the environment are classified as living, nonliving, and once living. Living things differ from nonliving things. Organisms are classified into groups by using various characteristics (e.g., body coverings, body structures).

SC-E-3.1.3 Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

SC-M-3.1.1 Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, tissues, organs, organ systems, organisms and ecosystems.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Background information: insect mouthparts differ significantly between groups, and recognizing insect mouthparts is an important step towards insect identification. This exercise relates insect mouthparts to common objects (i.e.: chewing mouthparts resemble pliers)

Assessment: Student chooses an insect of interest and makes a diagram or model of one body part (such as: front leg, wing, head, eye, etc) and discusses how the insect uses that body part to thrive in its environment.

III. Why are insects important to the environment?

a. The Web of Insects

Objectives: Youth demonstrate the importance of insects by using yarn to represent the links created by insects in the environment.

Source: U.K. Entomology. Contact info for a free copy of this activity:

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859-257-7453, blaken@uky.edu

Grade Level: K-3

Materials: spool of yarn

Setting: indoor or outdoor

Time: 15 minutes

Core Content Connections:

SC-E-3.3.1 Plants make their own food. All animals depend on plants. Some animals eat plants for food. Other animals eat animals that eat the plants.

SC-M-3.5.2 Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

IV. What insects live in WATER, and how is insect biology affected by water?

a. Three Bugs in a Tub

Objectives: Youth observe and compare the behavior and anatomy of several aquatic insects

Source: 4-H Cooperative Curriculum System Publications

Entomology III, "Dragons, Houses, and Other Flies," p30

Grade Level: any

Materials: aquatic dip net, observation tray

Setting: outdoor

Time: 1-2 hrs

Core Content Connections:

SC-E-3.1.3 Each plant or animal has structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.

SC-M-3.2.3 Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

SC-E-3.3.1 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

b. Are You Me?

Objectives: Youth learn the relationship between adult animals and their aquatic immature stages

Source: *Project WILD Aquatic*, page 14

Grade level: any

Materials: cardboard, markers, crayons

Setting: indoor

Time: 1hr

Core Content Connections:

SC-E-3.2.1 Plants and animals have life cycles that include the beginning of life, growth and development, reproduction, and death. The details of a life cycle are different for different organisms.

SC-E-3.2.2 Plants and animals closely resemble their parents at some time in their life cycle. Some characteristics (e.g., the color of flowers, the number of appendages) are passed to offspring. Other characteristics are learned from interactions with the environment such as the ability to ride a bicycle, and these cannot be passed on to the next generation.

Background Information: Many winged adult insects, such as dragonflies & mayflies. This exercise mentions those creatures, as well as other animals, and could be modified to include more insects, or only insects.

c. KY Water Watch Biological Assessment

Objectives: Youth learn how water quality affects aquatic arthropod populations

Source: KY Division of Water
14 Reilly Rd
Frankfort, KY 40601
502-564-3410 ATT: Ken Cooke

Grade Level: any

Materials: aquatic dip nets, white observation trays
Field Guide to Freshwater Invertebrates by Leska S. Fore
www.seanet.com/~leska

Setting: outdoor – stream, pond, lakes, and other water sources

Time: 2 hrs

Core Content Connections:

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

Background Information: different species of aquatic invertebrates (including insects, mollusks, worms, and other creatures) need different types of water to live, are more or less sensitive to water pollution. This exercise shows how scientists catch and observe invertebrates to determine water quality and pollution levels.

Assessment: Student creates a presentation detailing several kinds of arthropods that live in water, including their ecological role.

V. What insects live in SOIL, and how is insect biology affected by soil?

a. Ants & Antics

Objectives: Youth observe an ant colony

Source: 4-H Cooperative Curriculum System Publications
Entomology III, "Dragons, Houses, and Other Flies," p8

Grade Level: any

Materials: food for ants, paper

Setting: outdoor

Time: 1-2 hrs

Core Content Connections:

Scientific Inquiry

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

b. The Pillbug Project

Objectives: Youth investigate the habitat and food preferences of roly-polies by offering them choices.

Source: *The Pillbug Project*, by Robin Burnett, p 80-86

Grade Level: 5th-7th

Materials: plastic containers, sand, several fruits and vegetables, paper towels, and other items used to create choices

Setting: classroom

Time: 1-2 hrs

Core Content Connections:

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.2.3 Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

SC-H-3.2.2 Behavioral responses to internal changes and external stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.

SC-H-3.2.3 The broad patterns of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behaviors often have an adaptive logic.

Background information: This activity is designed to test any number of choices for pillbugs. Ask the students to think of ways to make the activity soil-oriented: for instance, a choice between wet and dry soil or a choice between soil and water.

c. Berlese Funnel Sampling

Objectives: Youth sample soil insects and observe insect diversity in different soil types

Source: U.K. Entomology. Contact info for a free copy of this activity:

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Lexington, KY 40546-0091
859-257-7453, blaken@uky.edu

Grade Level: 5th and up

Materials: Berlese Funnels, clear containers for observing insects, electricity source.

Setting: Outdoor

Time: 1-2 hrs

Core Content Connections:

Scientific Inquiry

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Assessment: Student creates a presentation detailing several kinds of arthropods that live in soils, including their ecological role.

VI. What insects live in FORESTS, and how do forests affect insect biology?

a. Sweep net sampling

Objectives: this will demonstrate a common method used to collect insects in vegetation, and will allow youth to observe insect diversity in different types of vegetation

Source: U.K. Entomology. Contact info for a free copy of this activity:

Blake Newton
Department of Entomology
University of Kentucky
S-207G Ag. Science North
Lexington, KY 40546-0091

859-257-7453, blaken@uky.edu

Grade: 5th and up

Materials: sweep net, white observation trays, plastic bags

Setting: outdoor

Time: 1-2 hrs

Core Content Connections:

Scientific Inquiry

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

b. Termite Trails

Objectives: Youth observe termites, learn about insect trailing behavior, and perform experiments

Source: UK Entomology. Activity available online at

www.uky.edu/Agriculture/Entomology/ythfacts/resourc/tcherpln/termtrails.htm

Grade Level: any

Materials: Papermate pens (blue), other writing utensils (markers, pencils, pens), blank paper, worker termites

Setting: Indoor

Time: 1 hr

Core Content Connections:

Scientific Inquiry

SC-E-3.2.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.2.3 Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

SC-H-3.2.2 Behavioral responses to internal changes and external stimuli can be innate or learned. Responses to external stimuli can result from interactions with the organism's own species and/or other species, as well as environmental changes.

Background Information: termites will follow one another using pheromone trails. The blue ink in certain pens mimics these pheromones. This activity

demonstrates social behavior among insects, and can also be used as a basis for experiments (using different inks, patterns, etc. as variables).

c. Things That Buzz At Night

Objectives: Youth learn about nocturnal forest insects and their behavior

Source: 4-H Cooperative Curriculum System Publications

Entomology II, "What's Bugging You?," p22

Grade Level: any

Materials: white sheet, rope, clear container, pencil, light source

Modification: this exercise works best when used with an ultraviolet "black light" bulb

Setting: nighttime in or near forest

Time: 1-2 hrs

Core Content Connections:

SC-M-3.2.3 Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

Background Information: flying insects are attracted to lights at night, especially UV blacklights. This exercise demonstrates this phenomenon, and allows students to discuss why insects have this behavior.

Assessment: Student creates a presentation detailing several kinds of arthropods that live in forests, including their ecological role.

VII. How is insect biology and diversity affected by differences between WATER, SOIL, and FOREST habitats?

a. Insect Sampling Comparison: Berlese Funnel, Aquatic Dip Netting, Sweep Netting

Objectives: Youth compare insect sampling techniques in different habitats and learn why certain sampling methods work in one habitat and not another based on anatomy and behavior of the insects that live in those habitats

Source: U.K. Entomology. Contact info for a free copy of this activity:

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Grade Level: 5th and up

Materials: Berlese funnels, isopropyl alcohol, hand trowel, collection vials, aquatic dip nets, white observation trays, sweep nets, plastic bags

Setting: outdoor and indoor

Time: 1-2 hrs for each sampling method; up to 6 hours over different class periods

Core Content Connections:

Scientific Inquiry

SC-M-3.2.3 Behavior is one kind of response an organism may make to an internal or environmental stimulus. A behavioral response requires coordination and communication at many levels including cells, organ systems, and organisms. Behavioral response is a set of actions determined in part by heredity and in part from experience.

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

b. Insect Observation Among Habitats

Objectives: Youth observe insects and their relatives in water, soil, and forest habitats. Based on observation, youth will discuss why creatures that live in one habitat are adapted to that habitat.

Source: U.K. Entomology. Contact info for a free copy of this activity:

Blake Newton
Department of Entomology
University of Kentucky
S-207G Ag. Science North
Lexington, KY 40546-0091
859-257-7453, blaken@uky.edu

Grade Level: any

Materials: notebook

Setting: Outdoor

Time: 1 hr for each habitat

Core Content Connections:

SC-E-3.3.2 The world has many different environments. Distinct environments support the lives of different types of organisms. When the environment changes, some plants and animals survive and reproduce, and others die or move to new locations.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

Assessment: Student creates a presentation detailing several kinds of arthropods that live in forests, including their ecological role.

Culminating Assessment

Field Guide To Insects and Their Relatives

Objectives: Youth work together to assemble a mini-field guide of the arthropods found living in their area. The field guide will not only list and describe the creatures, but will also discuss how they are adapted to their environment. Each youth chooses one arthropod and creates a one-page field guide entry which will include a sketch, description, where the arthropod was found, and other information, including how the arthropod adapted to living in water, soil, or on plants.

Each student should develop a page for the field guide that includes the following components:

- Accurate sketch, photograph, or digital image of the arthropod, with distinguishing characteristics highlighted and discussed.
- Taxonomy of the arthropod: scientific order and family name.
- Habitat where arthropod is found.
- Life cycle of the arthropod, with information for each part of the life cycle.
- A discussion on how the arthropod uses its anatomy and behavior to thrive in its environment (how it feeds, moves, escapes predation, disperses, etc.).
- Observations on the behavior of the arthropod: how it interacted with its environment under the observation of the student.
- Ecological role of the arthropod: what it eats, what eats it. Include other ecological contributions as well: is the arthropod a pollinator?
- Importance of the arthropod to humans, especially in the camp area.

4H Resources for Entomology

Essential Books

Peterson Field Guide to Insects: by Borror and White (apx \$20)
Spiders and Their Kin (Golden Guide): by Levi and Levi (apx \$7)
Butterflies and Moths (Golden Guide): by Mitchell and Zim (apx \$7)

Other Recommended Books

Peterson Field Guide to Beetles: by White (apx \$20)
National Audubon Society Field Guide to North American Insects and Spiders: by Milne et al (apx \$20)
Peterson First Guide to Caterpillars of North America: by Wright (apx \$7)
Simon and Schuster's Guide to Insects: By Arnett and Jacques (apx \$17)
Guide to Common Freshwater Invertebrates of N. America: by J. R. Voshell) (apx \$36)
Leaf Pack #KIT9429 Invertebrate Cards: Acorn Naturalists (1-800-228-8886) (apx \$35)
These laminated cards are a good additional resource for the KY Water Watch Biological Assessment activity.

Supplies

Aquatic Dip Nets – 10 inch - apx \$5 each at local pet stores
Sweep Nets - Gempler's, \$25-50 each
Larval Trays (white trays to observing collected insects) - Bioquip, #1426, \$8-10 each
Soft "Featherweight" Forceps (pick up insects without causing damage)- Bioquip, #4748, \$5 each
Collection Vials (store soft-bodied arthropods) - Bioquip, #8804P, 8806P, or 8808P, \$5-7 dozen
Isopropyl or Ethyl Alcohol (preserve collected insects)
Blacklight (to attract nocturnal insects) - Bioquip, #2805 (DC), 2804 (AC/DC), 2806 (AC), \$50-80 each
Berlese Funnel - Berlese funnels can be purchased or hand-made. Science Kit & Boreal Laboratories sells Berlese funnels for about \$45 each. Acorn Naturalists has a compact Berlese funnel for about \$60 each. Bioquip has a \$70 Berlese funnel (#2831). Berlese funnels can also be “homemade.” The following website has instructions for a simple Berlese funnel involving plastic soda bottles, wire screen, and a few other components:
www.archbold-station.org/discoveringflscrub/unit3/unit3b1part2.html
There is not just one way to make a Berlese Funnel. Check the Internet for other instructions, or design your own based on the principals suggested by the design in the website above.