University of Kentucky Department of Entomology Curriculum Guide

Insects in the Environment

Essential Question: "How Does The Environment Affect The Insects (and Related Arthropods) That Live in Kentucky?"

For Middle School (Grades 6-8)

The goal of this curriculum guide is to introduce students to insects and to understand how insect biology and diversity in Kentucky are influenced by environmental factors such as water, soil, and vegetation. This guide is designed to be used as an entire unit with assessments at the end of each section and a culminating assessment at the end of the guide. However, individual sections can be used to address specific questions. Please note that this is a guide and does not contain the actual activities: the activities referenced come from a variety of sources, each of which is listed along with the activity.

I. Why are insects important to the environment?

When completed, this section addresses the following KERA Academic Expectations:

2.3 Students identify and analyze systems and the ways their components work together or affect each other.

a. The Web of Insects

Objectives: Students 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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Materials: spool of yarn

Setting: indoor or outdoor

Time: 15 minutes

Program of Studies Connections:

S-6-LS-3 Observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.

Core Content Connections:

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.

b. Beneficial Bug Hunt

Objectives: Students search an outdoor environment for beneficial insects and spiders and learn how these creatures use their structures and behaviors to fulfill their ecological role.
Source: Kentucky Bug Connection: University of Kentucky department of Entomology website for Middle-High School: http://www.uky.edu/Agriculture/CritterFiles/casefile/bugconnection/teaching/teaching.htm
Materials: notepad, pencil
Setting: outdoors and indoor
Time: 1 hr for outdoor portion, 1-2 hrs for indoor discussion
Program of Studies Connections:
S-6-LS-3 Observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.
S-8-LS-4 Investigate and analyze populations and ecosystems
Core Content Connections:
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.

Assessment: Student is assigned an insect (or insect relative) and makes comparisons between that insect and another animal with similar ecological roles. For instance, a student may compare a spider with a predatory mammal (like a wolf) or a bee with a pollinating mammal (like a hummingbird). The student should compare the structures and behaviors of the two creatures, pointing out similarities and differences.

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

When completed, this section addresses the following KERA Academic Expectations:

2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and to predict possible future events.
2.3 Students identify and analyze systems and the ways their components work together or affect each other.

a. KY Water Watch Biological Assessment

Objectives: Students learn how water quality affects aquatic arthropod populations

Background Information: Different species of aquatic invertebrates (including insects, mollusks, worms, and other creatures) need different types of water to live and are more-or-less sensitive to water pollution. This exercise demonstrates how scientists catch and observe invertebrates to determine water quality and pollution levels. For middle school students, make sure to repeat this activity in at least 3 different aquatic habitats: a relatively clean stream, a relatively polluted stream, and a pond. Students should compare the types and numbers of aquatic invertebrates that they find in each habitat.

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

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

Program of Studies Connections:

S-6-LS-5 Investigate factors (e.g., resources, light, water) that affect the number of organisms an ecosystem can support.

Core Content Connections:

SC-M-3.5.4 The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

Assessment: Student creates a presentation (such as a poster or an interactive digital picture) detailing several kinds of arthropods that live in water, including their ecological role, the adaptations that they use to live in an aquatic environment, and the factors (e.g., pollution, predators, and oxygen levels) that limit their ability to survive in certain types of water.

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

When completed, this section addresses the following KERA Academic Expectations:

2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.

2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and to predict possible future events.
2.3 Students identify and analyze systems and the ways their components work together or affect each other.

a. Ants & Antics

Objectives: Students observe an ant colony and make simple scientific observations
Source: 4-H Cooperative Curriculum System Publications
Entomology III, "Dragons, Houses, and Other Flies," p8
Materials: food for ants, paper
Setting: outdoor
Time: 1-2 hrs
Program of studies connections:
S-6-SI-3 Use evidence (e.g. orderings, organizations), logic, and scientific knowledge to develop scientific explanations
S-6-LS-2 Analyze internal or external stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation.
S-7-SI-3 Use evidence (e.g. measurements), logic, and scientific knowledge to develop scientific explanations
S-8-SI-3 Use evidence (e.g. computer models), logic, and scientific knowledge to develop scientific explanations
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.

b. What Will Pillbugs Choose?

Objectives: Students investigate the habitat and food preferences of roly-polies by offering them choices.
Source: *The Pillbug Project*, by Robin Burnett, p 80-86
Background information: This activity is just one of many in The Pillbug Project. The whole book can be used as a unit and can serve to introduce students to soil creatures and the scientific method.
Materials: plastic containers, sand, several fruits and vegetables, paper towels, and other items used to create choices
Setting: classroom
Time: 1-2 hrs
Program of studies connections:
S-6-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.

S-6-SI-3 Students will use evidence (e.g., orderings, organizations), logic, and scientific knowledge to develop scientific explanations.
S-6-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.
S-6-LS-2 Analyze internal or external stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation.
S-7-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.
S-7-SI-3 Students will use evidence (e.g., measurements), logic, and scientific knowledge to develop scientific explanations.
S-7-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.
S-8-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.
S-8-SI-3 Students will use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
S-8-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.
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.

c. Berlese Funnel Sampling

Objectives: Students use Berlese funnels to sample soil insects and compare 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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Materials: Berlese Funnels, electric lamp, electricity source, clear containers for observing insects, soil testing materials (soil probe, soil color book, etc.)
Setting: Outdoor
Time: 1-2 hrs
Program of Studies Connections:

S-6-LS-3 Students will observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.
S-8-LS-4 Students will investigate and analyze populations and ecosystems.
Core Content Connections:
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.

Assessment: Student creates a presentation (such as a poster or an interactive digital picture) detailing several kinds of arthropods that live in soil, including their ecological role and the structures and behaviors that they use to live in their environment.

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

When completed, this section addresses the following KERA Academic Expectations:

2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.
2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and to predict possible future events.
2.3 Students identify and analyze systems and the ways their components work together or affect each other.

a. Sweep net sampling

Objectives: Students will use a common method used to collect insects in plants, allowing them to observe insect populations in different types of vegetation

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Materials: sweep net, white observation trays, plastic bags
Setting: outdoor
Time: 1-2 hrs

Program of Studies Connections:
S-6-LS-3 Students will observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.
S-8-LS-4 Students will investigate and analyze populations and ecosystems.
Core Content Connections:
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.

b. Termite Trails

Objectives: Students observe termites, learn about insect trailing behavior, and conduct simple scientific investigations
Source: Kentucky Bug Connection: University of Kentucky department of Entomology website for Middle-High School: http://www.uky.edu/Agriculture/CritterFiles/casefile/bugconnection/teaching/teaching.htm
Materials: Papermate pens (blue), other writing utensils (markers, pencils, pens), blank paper, worker termites, Petri dishes
Setting: Indoor
Time: 1 hr
Program of studies connections:
S-6-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.
S-6-SI-3 Students will use evidence (e.g., orderings, organizations), logic, and scientific knowledge to develop scientific explanations.
S-6-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.
S-6-LS-2 Analyze internal or external stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation.
S-7-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.
S-7-SI-3 Students will use evidence (e.g., measurements), logic, and scientific knowledge to develop scientific explanations.
S-7-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.

S-8-SI-1 Students will identify and refine questions that can be answered through scientific investigations combined with scientific information.
S-8-SI-3 Students will use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.
S-8-SI-4 Students will design and conduct different kinds of scientific investigations to answer different kinds of questions.
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.

Assessment: Student creates a presentation (such as a poster or an interactive digital picture) detailing several kinds of arthropods that live in forests, including their ecological role and the structures and behaviors that they use to live in their environment.

V. 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: Students compare insect sampling techniques in different habitats and to study the ecological roles 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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Materials: Berlese funnels, electric lamps, source of electricity, 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
Program of Studies Connections:
S-6-LS-3 Students will observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.
S-8-LS-4 Students will investigate and analyze populations and ecosystems.

Core Content Connections:
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.

b. Insect Observation Among Habitats

Objectives: Students observe insects and their relatives in water, soil, and forest habitats. Based on observation, students will discuss why creatures that live in one habitat are adapted to that habitat and what ecological role that they play.
Source: U.K. Entomology. Contact info for a free copy of this activity:

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Materials: notebook, pencil
Setting: Outdoor
Time: 1 hr for each habitat
Program of Studies Connections:
S-6-LS-3 Students will observe populations and determine the functions (e.g., decomposers, producers, consumers) they serve in an ecosystem.
S-8-LS-4 Students will investigate and analyze populations and ecosystems.
Core Content Connections:
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.

Assessment: Unknown insects: students are shown insects that they have not seen before and try to determine what type of habitat they live in (forest, soil, or water) and their ecological role based on their structures and behavior. It is okay if the students do not guess the right habitat or ecological role, but they should be able to justify their guess based on evidence from structures and behavior.

Culminating Assessment

Field Guide to Schoolyard Insects (and their Relatives)

Objectives: Students work together to create a field guide to the insects and insect relatives that live in a nearby outdoor habitat, such as a schoolyard garden. In the process, they will come to know the adaptations and ecological roles of the creatures that they study.
Source: Kentucky Bug Connection: University of Kentucky department of Entomology website for Middle-High School: http://www.uky.edu/Agriculture/CritterFiles/casefile/bugconnection/teaching/teaching.htm
Materials: notebook
Setting: any outdoor natural environment, such as a garden, meadow, flower bed, or crop (and indoors for discussion and construction of field guide)
Time: 1-2 hrs outdoors, plus 1-3 hrs total time indoors for research and field-guide construction
Program of Studies Connections:
S-6-LS-3 Students will observe populations and determine the functions (e.g. decomposers, producers, consumers) they serve in an environment.
S-7-LS-3 Investigate unity among organisms.
S-8-LS-4 Students will investigate and analyze populations and ecosystems.
S-8-LS-5 Students will analyze diversity and adaptations (e.g. changes in structure, behaviors, or physiology).
Core Content Connections:
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.
SC-M-3.5.32 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 consumer, 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.

Important Entomology Resources

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 (http://www.gemplers.com/), $25-50 each
Larval Trays (white trays to observing collected insects) – Bioquip (http://www.bioquip.com/), #1426, $8-10 each
Soft "Featherweight" Forceps (pick up insects without causing damage)- Bioquip (http://www.bioquip.com/), #4748, $5 each
Collection Vials (to store soft-bodied arthropods) – Bioquip (http://www.bioquip.com/), #8804P, 8806P, or 8808P, $5-7 dozen
Isopropyl or Ethyl Alcohol (to preserve collected insects)
Blacklight (to attract nocturnal insects) – Bioquip (http://www.bioquip.com/), #2805 (DC), 2804 (AC/DC), 2806 (AC), $50-80 each
Berlese Funnel - Berlese funnels can be purchased or hand-made. Science Kit & Boreal Laboratories (http://www.sciencekit.com/) sells Berlese funnels for about $45 each. Acorn Naturalists has a compact Berlese funnel for about $60 each. Bioquip (http://www.bioquip.com/) 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.