Standards-Based Module
(Lesson/Unit Plan)

Cover Page

Content Area: Life Science

Grade Level: 6 and 8

Title of Lesson/Unit: Introduction to Adult Insects and Their Adaptations

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Content Area(s): Life Science **Grade Level:** 6 and 8

Time to Complete: (3-4) 50 minute class periods

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1. South Carolina State Standards Addressed

Grade 6

The student will demonstrate an understanding of technological design and scientific inquiry, including process skills, mathematical thinking, controlled investigative design and analysis, and problem solving.

6-1.1 Use appropriate tools and instruments (including a spring scale, beam balance, barometer, and sling psychrometer) safely and accurately when conducting a controlled scientific investigation.

6-1.3 Classify organisms, objects, and materials according to their physical characteristics by using a dichotomous key.

The student will demonstrate an understanding of structures, processes, and responses of plants that allow them to survive and reproduce. (Life Science)

6-3.1 Compare the characteristic structures of invertebrate animals (including sponges, segmented worms, echinoderms, mollusks, and arthropods) and vertebrate animals (fish, amphibians, reptiles, birds, and mammals).

6-3.2 Summarize the basic functions of the structures of animals that allow them to defend themselves, to move, and to obtain resources.

Grade 7

The student will demonstrate an understanding of technological design and scientific inquiry, including process skills, mathematical thinking, controlled investigative design and analysis, and problem solving.

7-1.1 Use appropriate tools and instruments (including a microscope) safely and accurately when conducting a controlled scientific investigation.

7-1.5 Explain the relationships between independent and dependent variables in a controlled scientific investigation through the use of appropriate graphs, tables, and charts.

Grade 8

The student will demonstrate an understanding of technological design and scientific inquiry, including process skills, mathematical thinking, controlled investigative design and analysis, and problem solving.

8-1.3 Construct explanations and conclusions from interpretations of data obtained during a controlled scientific investigation.

8-1.6 Use appropriate tools and instruments (including convex lenses, plane mirrors, color filters, prisms, and slinky springs) safely and accurately when conducting a controlled scientific investigation.

The student will demonstrate an understanding of Earth's biological diversity over time. (Life Science, Earth Science)

8-2.1 Explain how biological adaptations of populations enhance their survival in a particular environment.

2. Lesson/Unit Description:

Students will be introduced to organisms found in Class Insecta and the different adaptations these organisms have developed over time to survive and prosper in their respective habitats. They will also learn the origin of the names of several orders within Class Insecta and be able to identify the key physical characteristics that separate one order from another. The students will then split into teams, observe and then collect insects from different habitats, and identify the insects to order using a dichotomous key (provided). Finally, the students will make frequency histograms showing the make-up of insects they found in each of the habitats the teams sampled and discuss the difference in insect make-up in the different habitats sampled by all the teams and any insect adaptations they may have observed.

3. Focus Question(s) for Students:

1. What criteria are used to determine if an animal should be classified as an insect?
2. What do the Latin/Greek ordinal names mean? Do they give you an idea of the key characteristic(s) of that order?
3. How do you use a dichotomous key?
4. What are some insect adaptations you observed while collecting in your assigned habitat?

4. Culminating Assessment:

1. Show pictures of various insects, introduce them to the characteristics that classify them as insects, and show the students the key characteristics used to identify the insects to order (refer to PowerPoint presentation). As you show the images to the students, have them infer part of the insects natural history based on physical characteristics (i.e. wings = flying, muscular back legs = jumping, large eyes in the front of the head= hunting or predator, piercing mouthpart = sucking plant and animal juices, green = found in vegetation, etc.). The Latin/Greek definitions of the insect order names are included in the presentation.
2. Quiz: discuss as a class what the students inferred about the natural history of the insect featured in the quiz pictures (see PowerPoint presentation), included in the quiz will be pictures of non-insects so that the criteria used to classify an organism as an insect is reinforced.
3. Have the students write down every couplet they used in the dichotomous key to identify their insect.
4. Compare the frequency histograms from one area to another, focusing on why one area has more or less insect orders than another. Discuss possible insect adaptations to their habitat based on field observations and collection data (especially niche information).

<u>Student Directions for Assessment:</u>

1. Adult Insects: have the students infer part of the insects natural history based on physical characteristics of the insects shown in the presentation. Discuss this as a class.

2. Quiz: have the individual student write down on a piece of paper: if the organism pictured is an insect and describe a part of the natural history of that insect based on the physical characteristics discussed previously as a class (quiz included in the PowerPoint presentation).
3. Classify collected insect specimens using dichotomous keys (see student handout). (Try to identify at least 15 insects from at least six different orders.)
4. Create a frequency histogram (included in the student handout) to show the distribution of insects from one habitat to another.
5. Compare histograms from the different habitats.
6. Discuss the characteristics of the insects found in each habitat. Can you identify adaptations the insects have developed for living in these habitats?

5. Materials/Equipment/Resources:

Materials Per Class:

Access to a computer and projector
Butterfly/moth jars (*in SC LIFE equipment footlocker*)
Sweep net and beat sheet (*in SC LIFE equipment footlocker*)
Moticscope (microscope camera) (*in SC LIFE equipment footlocker*)
Aspirator or pooter (*in SC LIFE equipment footlocker Fall 2005*)
Field guides (*see Additional Resources section*)
Nailpolish remover with Acetate
Cottonballs
Access to a freezer or alcohol
Collection vials (can use prescription containers donated from local pharmacy, baby food jars, etc.)

Materials Per Group:

"Kill jar" with treated cottonballs
Masking tape or label tape (to label group jars) and pencil or pen
Collection vials (for the insects going in the freezer or alcohol)
Hand lens or magnifying glass
Forceps (*in SC LIFE equipment footlocker*)

Materials Per Student:

Student Handout
Ruler
Colored markers or pencils and graph paper
or create the histogram in Excel

6. Teacher Preparation:

1. Read Background Information and be prepared to explain how to identify the insects to order (refer to teacher supplement if needed) and be familiar with the different habitats where they can be found.
2. Make sure PowerPoint presentation is ready and make copies of the student handout.

3. Locate a natural area where students may look for insects. Preferably, this will be an area that differs obviously from one part to the other. Be sure to check out any restrictions on specimen collection.
4. Prepare and obtain materials/equipment (refer to teacher supplement if needed).
5. Separate students into working groups of four.

Background Information

1. Identifying adult insect characteristics
    A. Invertebrates
    B. Have segmented body regions (3 parts= head, thorax, abdomen)
    C. 1 pair antennae
    D. 3 pair of walking legs (six legs in total)
    E. Jointed appendages (greater flexibility and movement, belong in the Phylum Arthropoda which literally means jointed appendages)
    F. Exoskeleton (made of chitin (a polysaccharide) and protein for protection from predators and water and heat loss, but still allowing the freedom of movement. The drawback, however, is size limitation.)
    G. Mandibles
    H. Most numerous and most diverse groups on earth due to their small size, exoskeleton, and flexible body plan (see pictures in presentation)
    I. only adults insects can have wings, however, not all adult insects have wings
    J. Relatives: millipedes, centipedes, spiders, scorpions, shrimp, crayfish, etc.
2. They are the largest groups of species
    A. approximately one million identified species of insects and an estimated 10 times that number still remaining to be identified, some experts think it can be as much as 30 times that number (30 million)
        i. make up 53% of all known living species of organisms
        ii. approximately 73% of all known living species of animals
3. Have lived on this earth for 350 million years (compared to 2 million for humans) which has given them time to diversify and multiply
4. Insects have adapted to almost any environment (due to their flexible body plan), and has occupied almost every habitat imaginable.
    A. Aquatic environments:
        i. fresh water: caddisflies (Trichoptera), mayflies (Ephemeroptera), stoneflies (Plecoptera), flies (Diptera), dragonflies and damselflies (Odonata)
        ii. marine (coastal only): caddisflies (Trichoptera)
        iii. adaptations for living in water (leaf litter in stream, pools, riffles, runs, under rocks, in sediment):
            a. larvae: gills (Plecoptera and Ephemeroptera), protective cases that can be camouflaged (made of sand, wood, or rocks and held together with silk) (Trichoptera), silk "nets" used to passively catch food in the water column (Trichoptera), streamlined bodies (some Plecoptera and Ephemeroptera)

B. Terrestrial environments:
   i. treetops: caterpillars (Lepidoptera) can be camouflaged to resemble the vegetation, parasitic wasps (Hymenoptera) have to have good eyesight to be able to spy the hidden caterpillars
   ii. soil: those beetles (Coleoptera) that live in the soil are usually quite small, mole crickets (Orthoptera) have modified front legs for digging in the soil
   iii. grasslands: butterfly pupal cases (Lepidoptera) can be camouflaged to resemble a dried leaf, grasshoppers (Orthoptera) can be green to resemble the vegetation, milkweed bugs (Hemiptera) have a piercing mouthpart to drink plant juices, bee flies (Diptera) look like bees, bees (Hymenoptera) are striped yellow and black to warn of the danger of messing with them
   iv. forests: beetles (Coleoptera) can be camouflaged to look like bark, treehoppers (Homoptera) can be camouflaged to look like plant thorns and have piercing mouthparts to drink plant juices
   v. leaf litter: larval flies (Diptera) can be found protected in this niche, springtails (Collembola) have springs that allow them to escape quickly from predators
   vi. caves: cave crickets (Orthoptera) usually have reduced eyes

C. Internal environment:
   i. In your skin: bot flies (Diptera) can breathe and defecate through the same hole in your skin!
   ii. The female botfly glues her eggs to a blood sucking arthropod (mosquito, tick, biting fly, etc.) who then lands on you for its meal.
   iii. The egg hatches upon contact with your warm skin and the larva will then burrow into your skin, living its juvenile life as an internal parasite.
   iv. The larva stays under your skin, remaining anchored to a hole in your skin so that it can breathe and defecate, absorbing nutrients from your body. It is not small, and you can feel it moving.
   v. It takes several weeks to reach the pupal stage.
   vi. When it is a mature larva, it will emerge from your body, drop to the soil and pupate.

5. Introduction to the insect orders (see Teacher supplement for more info)
   A. Collembola
   B. Diptera
   C. Odonata
   D. Ephemeroptera
   E. Hemiptera
   F. Homoptera
   G. Orthoptera
   H. Mantodea
   I. Phasmida
   J. Blattaria
   K. Thysanoptera
   L. Plecoptera
   M. Mecoptera

N. Dermaptera
O. Coleoptera
P. Lepidoptera
Q. Trichoptera
R. Isoptera
S. Hymenoptera

7. Procedures:

1. Introduction to the Topic:
    A. Use the PowerPoint presentation to show the diversity of insects, especially body shapes and colors; show them insects they are likely to collect in the field.
2. Teacher Directed Discussion:
    A. During the presentation, have the students come up with a part of the natural history of the insect shown on the screen based on its morphology (form or physical characteristics). Get them thinking about what characteristics would help an insect adapt to their environment.
    B. Also during the presentation, discuss the key identifying characteristics of the insect orders and the interesting habitats insects have exploited.
    C. For the quiz (included in the PowerPoint presentation), have the students write down the featured insect's natural history using what they discussed during the presentation as a guide.
    D. After the students have finished their histograms, discuss what insect orders dominated the different habitat types and if the students found some orders only in certain habitats (i.e. green grasshoppers in the grass and colorful butterflies on the flowers, etc.).
3. Equipment and Skills Demonstration:
    A. Show the students how to use a sweep net, beat sheet, and a pooter and how to collect the insects in a vial without destroying the specimen (or having the students getting stung or bitten). Also, show them how to use the "kill jar" (refer to teacher supplement if needed) and how to use forceps.
    B. Show the student how to use a stereoscope (if used).
    C. Observe the insects and take digital pictures of the specimens using Moticscope (if used).
    D. Walk students through the dichotomous key once or twice to show them how it works.
    E. Show the students how to express their frequency table graphically in a frequency histogram.
4. Student Activity:
    A. Field Collection
        i. Make sure that each student in the group knows which role they play: Data Keeper (makes the labels for the collection vials and keeps track of the samples collected), Collector #1, Collector #2, and Insect Specialist (makes sure all labels and data are correct and that only insects are collected).

ii. Leave the butterflies and moths in labeled "kill jars" overnight, place the remaining labeled insects collected in their jars in the freezer or in alcohol if that is being used instead.

B. Experimental Design
   i. Discuss how the students are to graphically display their data in a histogram (include scale – how big to make the chart).

C. Independent Practice
   i. Each students will make their own histogram of their groups data and write a paragraph explaining the data in the histogram.

8. Differentiation of Instruction:

1. Gifted and talented students can access web sources from the recommended list to enrich their learning experience.
2. Students unable to participate in field experiences can access virtual field trips through various websites and CDs.

9. References

Arnett, Ross H. Jr. and Richard L. Jacques, Jr. 1985. Insect Life: A Field Entomology Manual for the Amateur Naturalist. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Borror, Donald J., Charles A. Triplehorn, and Norman F. Johnson. 1989. An Introduction to the Study of Insects. Harcourt Brace College Publishers, New York.

Brigham, Allison R., Warren U. Brigham, and Arnold Gnilka, editors. 1982. Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois.

Imes, Rick. 1992. The Practical Entomologist. Simon & Schuster, Inc. New York.

Merritt, Richard.W. and Kenneth W. Cummins. 1978. An Introduction to the Aquatic Insects of North America. Kendal Hunt Publishing Company, Dubuque, Iowa.

10. Additional Resources

Web Sources:

http://virtual.clemson.edu/groups/SCLife/weblinks/Animal%20Links.htm

http://www.clemson.edu/public/

Click on Information, then Publications, then you can browse by topic "Entomology"

http://entweb.clemson.edu/
Click on Insect Information, then Insect Information Series

http://www.bugwood.org

Books:

Bland, Roger G. and H.E. Jacques. 1978. How to know the insects, 3rd edition. Wm. C. Brown Company Publishers, Dubuque, IA.

Borror, Donlad J. and Robert E. White. 1983. Insects: Peterson field guides. Houghton Mifflin Company, Boston or New York.

Dunn, G. A. Six-Legged Science: Insects in the Classroom. Young Entomologists Society, Lansing Michigan. 1991

Ramos-Elorduy, Julieta. 1998. Creepy Crawly Cuisine. Park Street Press, Rochester, Vermont.