Web Unit Plan

Title: Insects: The Good, the Bad, and the Ugly

Description: Insects are often regarded as disgusting, squishable annoyances. In this unit, students become entomologists and investigate the role insects play in our lives and the world around us.

At a Glance

Grade Level: 6–8

Subject: Science

Topics: Insects, Ecology

Higher-Order Thinking Skills: Analysis, Investigation, Experimental Inquiry

Key Learnings: Classification, Anatomy, Food Webs, Adaptation, Experimental Design, Research

Time Needed: 4 weeks, daily lessons

Unit Summary

In this unit, students become entomologists and investigate insects from the twin human perspectives of benefit and hazard. Students study insects and learn about their behaviors, anatomy, taxonomy, and ecological importance. Scientific method is taught through experiments with insects in which variables are manipulated. In a final project, students present what they have learned through the lens of entomologists working in various professional fields.

Curriculum-Framing Questions

- **Essential Question**
  How are things around me helpful or harmful?
- **Unit Questions**
  How do insects affect me?
  What makes an insect an insect?
  Would we be better off with no insects in the world?
- **Content Questions**
  How do I classify insects?
  How do insects fit into the food web (chain)?
  What role do insects play in the environment?
  What are the names of different parts of insects' bodies?
  How do I organize and analyze data?

Assessment Processes

View how a variety of student-centered assessments are used in the Insects: The Good, the Bad, and the Ugly Unit Plan. These assessments help students and teachers set goals; monitor student progress; provide feedback; assess thinking, processes, performances, and products; and reflect on learning throughout the learning cycle.

Instructional Procedures

Week 1: Days 1 and 2
Setting the Stage

Ask the class the Essential Question, *How are things around me helpful or harmful?* After some discussion, ask if there are things in life that seem pesky or harmful but are really helpful.

Ask the Unit Question, *How do insects affect me?* Stimulate further discussion by asking students to share their "worst" or "best" insect stories. People receive a lot of information about bugs through TV or movies. Have students recall how and what movies portray insects.

Ask students the Unit Question, *Would we be better off with no insects in the world?* Ask students to think of reasons why we might be better off with insects alive than dead. Have students list insects they commonly encounter and indicate whether they think each is harmful or beneficial to humans. Record answers on a piece of butcher paper.

Inform students that they will become entomologists over the coming weeks and their job will be to answer the Unit Question, *Would we be better off with no insects in the world?* Tell them that they will be working in groups, each with a focus on the way entomology is used in a professional field (ecology, agriculture, bioengineering, anthropology, forensics, chemistry, evolutionary biology, or robotics). Explain to the class that they will analyze various activities through the lens of a professional field.

Group students, and have groups choose the professional field they want to assume. Start students thinking about their professional roles by doing a preliminary investigation of the fields they selected. Then, have students generate a list of questions they want to answer about insects from the viewpoint of the professional role.

Consider having students read insect poems aloud from *Joyful Noise: Poems for Two Voices,* by Paul Fleischman, as an extra activity.

Week 1: Days 3 through 5
Background Knowledge

Introduce the topic of insect study with electron microscopy insect images from Bugscope* (Bugscope is an educational outreach project of the Beckman Institute. Participating classrooms from around the nation can view insects from their classroom, and even control an Environmental Scanning Electron Microscope from their Web browser.) Consider using the animated/virtual reality site 3-D Insect* as well. Ask students to name any insect anatomy they recognize, and tell about specialized functions they know.

To provide a preliminary study of insects, project the Earthlife Insect Quiz* and have the class consider the questions together, defending and then voting for their choices. Select the majority answer for each question. The quiz should start a lot of discussion about the Unit Question, *What makes an insect an insect?* as well as discussion about the many types or orders of insects and other "bug" groups, like spiders and crustaceans. This is a good time to introduce students to new insect vocabulary.

Collect, or have students collect, a variety of insects to bring to class. Make sure you discuss the least-harmful ways of collecting in advance. After initial observation, have students determine their own organization scheme for sorting their organisms into groups and ask the Unit Question, *What makes an insect an insect?* (The first

distinction is *Insect* or *Not Insect*. Students will most likely bring in pill bugs, spiders, even worms. You may want to do this first sort together as a class.)

After airing their sorting schemes, settle on a few agreed-upon categories, and have students sort the insects. Let students know that, because there are so many different kinds of insects, classifying them can be very difficult. Even professional entomologists aren't sure all the orders have been identified. Introduce the taxonomy and classification system used in science (kingdom, phylum, class, order, family, genus, species). Show how this breaks down from the order (insect) level, using flies as an example:

- Kingdom .....Animalia
- Phylum .....Arthropoda
- Class .....Insecta
- Order .....Diptera
- Family .....Muscidae
- Genus .....*Musca* (fly)
- Species.....*Musca domestica* (housefly)

Discuss similarities, differences, and the Unit Question, *What makes an insect an insect?*

(***For your information:*** Due to differences in how scientists classify insects, variations exist regarding the number of orders. "Experts" classify 25 through 35 orders. A widely used classification system in the United States is the one used in the textbook *An Introduction to the Study of Insects,* by Borror, Triplehorn, and Johnson, which lists 31 insect orders. Interestingly, a new insect order—the first in 87 years—has been recently identified in Africa.)

Distribute the orders of insects handout and lead a discussion about the different orders of insects.

Have students meet in their groups and brainstorm ways in which classification and taxonomy would be helpful to a person working in their professional field. Ask students to choose an order to study that would be relevant to their professional field.

Inform the groups that they will be creating a brochure. Show a sample brochure and distribute the brochure rubric. For the order of insect each group investigates, they should research the following:

- Basic anatomy
- Life cycle
- Habitat
- Adaptive and defensive features and strategies
- Where the insects exist in the food chain or web and their roles in the environment
- Extremes (show the biggest/smallest, fastest/slowest, rarest/most common, and so forth from this order)
- Local insect species in the selected order (if any)
- Ways insects in the selected order are harmful or beneficial to humans from the perspective of the selected professional field

Allow time for students to research their orders using electronic and print resources. If necessary, provide instruction on formatting and design for the brochure.

Weeks 2 and 3
Experimental Design and Study
Observational Study

For this first part of the project, students study insect life in one small *Square of Life*. This is an identified piece of land 10 feet square which could be in the schoolyard, backyard, nearby park, or wild area. Consider contrasting wild and managed squares. Stress that this is an observational study, not one where variables are manipulated. Experiments come later. See the square of life handout.

On the first day, instruct students to sit quietly in their Square of Life for 15 minutes and observe all the sorts of insects moving about, feeding, capturing prey, building homes or just resting. Remind students to look for signs of insects, such as discolored, curled, or chewed leaves, and frass or spittle. This should get students to start thinking about new questions about insects.

Upon returning to class, ask students what kinds of information they'd like to collect in their future field studies, and make a public list. Encourage both one-time and serial observations (some groups might answer a new question each day while others might study the same phenomenon day after day). Have groups decide what they'd like to study and then share their plan with the larger group. Show students how to write a question that has a quantifiable answer and show examples and non-examples. Explain how a research sequence works, and set an expectation for an oral report that reflects the following parts:

- Question or hypothesis
- Research design
- Data collection method
- Results
- Analysis and interpretation
- Discussion

Collecting and Organizing Data from Observational Study

Have students open a copy of the spreadsheet template and add their quantifiable observational categories (for example, number of insects, amount of captured prey, amount of built homes, or average amount of movement). Beginning in columns B in row two of the chart, have students type in one category per cell. Inform students that on each day of their observation they will fill in the date in column A and their observational data in columns B and beyond (depending on how many categories they have defined). Have them name the file and save the changes. If they wish, students can print a hard copy to use when conducting their observational data collection. Before beginning the data collection process, have students predict what they think the observational data results will be.

During subsequent field studies, provide students with observation tools, such as magnifying glasses and containers to hold insects for quick study. Let students use still or video cameras to record insects observed in their square.

Have students keep a daily field journal for observations and sketches. Give students time at the end of each field session for reflective writing and entering their data into the spreadsheet. You may want to have a set of research tasks in reserve that you can assign to groups that find their research question unanswerable or quickly completed.

Throughout the week, do as much insect identification and classification as possible, making taxonomic charts for classroom display.

Analyzing Data from Observational Study

After students have completed their week of observation and data collection, have students use the analyzing data worksheet to calculate sums and averages, interpret their data, and create graphs. Later, this data can be imported into the students' final presentation.

Have students practice and then present their observational studies to the class. They should report on their question, research design, data collection method, results, analysis and interpretation, and discussion.

Have students meet in their groups and brainstorm experimental questions that are relevant to their professional fields. Brainstorm ideas, and look through books that outline insect experiments students might pursue, such as discovering whether ants are attracted more to sugar on a stick or molasses.

Experimental Study

Students should have an idea of research structure now, and they should be ready to understand the more formal research steps for experimental study. Tell groups that they will be creating a scientific journal that will include the parts of a formal experimental study. Show the sample scientific journal and hand out the journal scoring guide. Have students structure their research as before, but this time, have them write a formal proposal for their study, including:

- Hypothesis
- Research design
- Controls for independent variables
- Data collection methods
- Materials
- Subjects safety statement (no insects should be harmed in the experiments)

After proposals are approved, set aside a week for experimental studies. Make sure groups have assigned specific roles to each student within the group (such as one student is responsible for data collection, another is responsible for research design, and so forth).

After students collect data, meet with students periodically to help them organize their work, make graphics to help communicate their research, discuss findings and interpretations, and place information in scientific journals. Suggest including the following elements in their journals:

- Digital pictures
- Graphs and charts
- Scanned drawings
- Background information

Week 4
Presentation

Tell students that the final project is to create a presentation to inform the class about the importance of insects in a professional field. For example, an entomologist in agriculture or forensics would view the importance of insects differently than an

entomologist in bioengineering or chemistry. Have the students use slideshow software to create presentations that include the following:

- Overview of the selected professional field
- Description of how insects are useful in the selected professional field
- Specific examples of entomological research in the selected field
- Discussion about the brochure and scientific journal created earlier in the unit
- Response with justification to the question, *Are insects helpful or harmful?*

During the course of the week, assist students with finding resources and organizing information using slideshow software.

At the end of the week, provide time for presentations and assess them using the project rubric.

To sum up the unit, ask students the Unit Question, *Would we be better off with no insects in the world?* and compare answers to what was written on butcher paper at the beginning of the unit.

Prerequisite Skills

- Students should be familiar with research using the Internet and print media. They should have fundamental skills with word processing, slideshow, and spreadsheet software.

Differentiated Instruction

Resource Student

- Provide a variety of resource materials to accommodate different learning modalities
- Provide a daily schedule of tasks to be completed with a visual checklist
- Provide models and examples of acceptable work
- Allow extended time and/or shortening of assignments
- Allow the brochure and scientific journal content to be presented verbally
- Make accommodations and modifications outlined in the student's Individual Education Plan (IEP)

Gifted Student

- Ask the student to provide more in-depth information or analysis in the projects
- Encourage the student to use resources that are from higher grade levels

English Language Learner

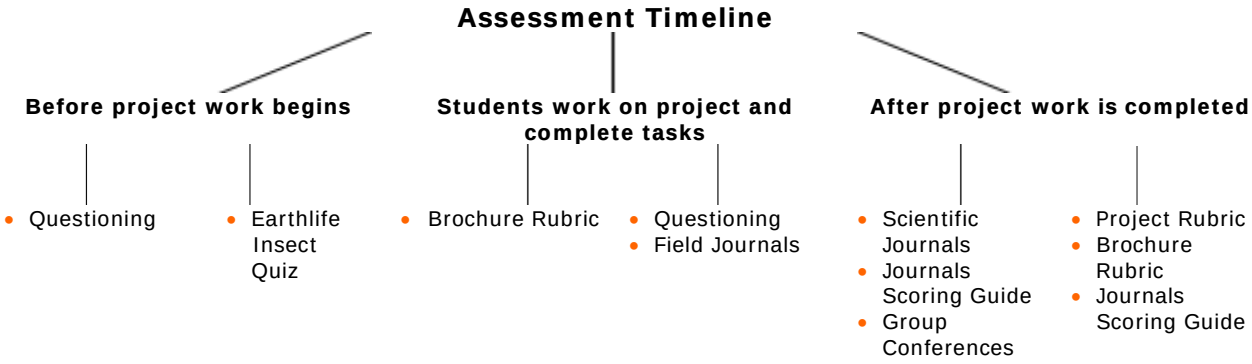
- Group the student with a more proficient bilingual student or community volunteer
- Provide templates in the student's first language
- Provide resources in the student's first language

Credits

A teacher participated in the Intel® Teach Program, which resulted in this idea for a classroom project. A team of teachers expanded the plan into the example you see here.

THINGS YOU NEED (highlight box)

Assessment Plan



Questioning is used throughout the unit to help students develop their higher-order thinking skills and process content. The Earthlife Insect Quiz* serves as an informal initial assessment, while the quality of scientific journals, field journals, and research worksheets help both teacher and students to monitor progress and understanding of content. Use the journal scoring guide to assess experimental studies in their scientific journals. Team group conferences are used to help monitor progress and answer any questions. Ask students to use the project rubric and brochure rubric to help them self- and peer-assess work on these projects prior to completion. Use these same rubrics to assess and grade their final presentations and insect order brochures.

Targeted Content Standards and Objectives

Oregon Common Curriculum Goals, Science, Grade 8

- Understand the characteristics, structure, and functions of organisms.
- Understand the relationships among living things and between living things and their environments.
- Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations.
- Collect, organize, and display sufficient data to support analysis.
- Summarize and analyze data including possible sources of error.
- Explain results and offer reasonable and accurate interpretations and implications.

Student Objectives:

Students will be able to:

- Describe relationships among various insects (such as predator/prey, parasite/host, food chains, and food webs)
- Identify physical features of orders of insects and how these traits help insects survive in different environments
- Investigate and share knowledge about local insects, and ways insects can be helpful or harmful to the environment
- Understand that “harmful” and “beneficial” are relative, human-centric terms

- Develop research skills, including observing, recording data, acquiring information, analyzing, and interpreting data
- Learn spreadsheet skills, such as setting up a spreadsheet for data organization and analysis, entering data over the course of a study, using functions, and choosing and displaying data appropriately
- Learn about designing experiments to test theories
- Increase environmental awareness regarding insects

Materials and Resources

Printed Materials

- Bernard, R. (1998). *The bug book.* New York: Scholastic.
- Borrer, D. J., Triplehorn C. A., & Johnson, N. F. (1989). *An introduction to the study of insects.* Philadelphia, PA: Saunders College Publishing.
- Fleischman, P. (1989). *Joyful noise: Poems for two voices.* New York: HarperCollins.

Supplies

- Magnifying glasses
- Breathable containers
- Temporary terrarium habitats
- Measuring tools, including stopwatches, tape measures, and calipers
- Field identification guides, such as Petersen's or Golden Book

Internet Resources

- Bugscope 3D Gallery
  http://bugscope.beckman.uiuc.edu/diversions/3d*
  3D bug anatomy
- 3D Insects
  www.ento.vt.edu/%7Esharov/3d/3dinsect.html*
  3D bug anatomy
- Earthlife Insect Quiz
  www.earthlife.net/insects/insect-test01.html*
  Online bug quiz

Technology—Hardware

- Computers with Internet access for conducting research, viewing insects, and completing quizzes
- Camera (digital if possible) and scanner for adding images to journals
- Printer for creating journals
- Projector for displaying slideshow presentations

Technology—Software

- Desktop publishing to design brochures
- Image processing to process pictures for presentations
- Internet Web browser for conducting research
- Multimedia to design multimedia presentations
- Word processing for written work during unit
- Spreadsheet for data entry and charts