Wisconsin NatureMapping Milkweed Community Study

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Learning Objectives:

Students should be able to:

1. Recognize and appreciate the role of scientific research in understanding the natural world.
2. Recognize and describe the role of controlled, manipulated, and response variables in scientific research.
3. Identify and understand the interactions between biotic and abiotic factors in a community.
4. Integrate research data and results into an overall understanding of an ecosystem.
5. Recognize and understand the affects of air pollution on ecosystems.
6. Make informed decisions regarding ecological issues by having a respect for both living things and the scientific process.

Note to Teachers:

Students should have background knowledge and experience in scientific observation, experimental design, milkweed identification, milkweed community member identification, and milkweed monitoring. Refer to the background information and links for resources that provide additional information.

I strongly recommend that this project be broken into smaller sections similar to the five parts outlined in the procedure below. I have assigned each of the parts separately as to not overwhelm the students. When I gave students the first part, milkweed community field observations, I gave a guideline sheet with the procedure and included a note indicating that the data they were to collect would be compiled and used in a future project.

I designed this project to be completed both individually (Part 1) and as a small group (Parts 2-5), but all parts of this project can be done by a student individually. In addition, I designed the project to be completed both as homework (Part 1 & 2) and during in-class work-time (Parts 3, 4, & 5). Although much of Parts 3-5 should be completed during in-class work time when students can collaborate with their group members, students may need to complete portions of those sections as homework.

This project would be great for use in summer school or summer camp. However, if you plan to include observations of milkweed for ozone injury the best times to make the observations are late July and early August.

Materials:

- Areas of milkweed plants (this can be literally anywhere that students are able to find milkweed plants, such as an old field, along a road, etc.).
- Several copies of milkweed community field guides: *Milkweed, Monarchs and More: A Field Guide to the Invertebrate Community in the Milkweed Patch* by Ba Rea, Karen S. Oberhauser, and Michael A. Quinn
- Hand lens
- Notebook
- Pen/Pencil
- Data table (printed from website)
- Computers with Internet access for inputting data
- Computer software (Microsoft Excel) for data analysis

Student Procedure:

Part 1: Field Observations/Data Collection

1. Print a data collection sheet from the NatureMapping website.
2. Select a study area—this may be any area that has at least one milkweed plant. Although this area can be adjacent to a roadway, it is not suggested that areas are close to busy roadways for safety reasons. If you are unable to locate milkweed, please see your teacher for suggestions.
3. Imagine that you are placing a 1-meter box or hoola-hoop around your milkweed plant and begin observing anything that you see within that imaginary box.
4. Before recording your observations on your data collection sheet, **wait 3-5 minutes!** Walking up to the plant will likely scare some of the organisms into hiding.
5. While you are waiting to begin your observations create a detailed sketch of your study area, which can be used to note where (e.g., top of plant, underside of leaf) you observe organisms.
6. Record all of your observations on your data collection sheet. Be very detailed!!!
7. **Repeat this activity** using the same location at a different time during the same day OR preferably on a different day.
8. This part of the project will be assessed using the following criteria:
   A = Three data collections (complete and done well)
   B = Two data collections (complete and done well)
   C = One data collection (complete and done well)

Special Notes for Field Observations:

- Do not worry about trying to determine the latitude and longitude of your study area when you are in the field! When you complete your field observations, utilize the "Geo-locator Map" on the Wisconsin NatureMapping website to determine the latitude and longitude of your milkweed community study area.
- If you are not able to positively identify an organism that you observed, you should sketch it and write a detailed description of its appearance. After you return to school, consult one of the milkweed community field guides (i.e., "Milkweed, Monarchs and More: A Field Guide to the Invertebrate Community in the Milkweed Patch") to help you identify the unknown organism.

Part 2: Data Entry

1. Enter your field data on the Nature Mapping website:
    a. Go to WI Nature Mapping website: http://www.wisnatmap.org/
    b. Select "Projects" from the top toolbar.
    c. Select "Milkweed Community Study" from the list of projects.
    d. Follow the prompts and directions provided in the database.
    e. Be sure to click the "Submit Data" button before exiting the site!!

Special Note: The data that you collected and are entering in the Nature Mapping Special Projects database will be compiled with your classmates' data along with the data of other students' from around the state.

Part 3: Design an Investigation

1. Select 2-3 other people to work with on this part of the project.
2. Select ONE of the following dependent variables (i.e., what was measured) and record in your lab notebook:

a. Abundance = # of organisms
-Overall
-Herbivores (H), Carnivores (C), or Omnivores (O)
-Specific type such as ants, grasshoppers, spiders, etc.

Example: overall number = 10 (H= 6, C = 4, & O = 0)

b. Diversity = # of different types
-Few different types = Low diversity
-Many different types = High diversity

Example: Overall = 10, H = 6, C = 4, O = 0
Diversity = 2 (only 2 types--H & C)

(Important Note: You may choose to quantify species diversity in your milkweed community by using a mathematical measurement known as a diversity index such as Simposon's Diversity Index or Shannon's Diversity Index. Such diversity indices provide more valuable information about community composition because they consider more than just the total number of different species (richness). These calculated indices also take into account the relative abundance of the different species in a community.)

3. Select an independent variable (i.e., what was manipulated/changed or varied naturally) from the data and record it in your lab notebook. The following are a few examples of possible independent variables:

- Distance from the Road

- Temperature
- Other Weather Conditions
- Position on the Plant
- Number of Surrounding Milkweed Plants
- Health of the Milkweed Plant
- Location of the Plant (City vs. Country OR Residential vs. Commercial)
- Time of Observation
- Amount of human activity
- Type of human activity
- Noise in the Area
- Etc . . .

4. Formulate a research question based on your selected variables and record it in your lab notebook.
5. Brainstorm a list of <u>at least 5 possible answers</u> to your research question and record them in your lab notebook.
6. Analyze each possible answer and determine which one is most probable. This is your **hypothesis** (educated guess) about the answer to your question. Your hypothesis should be *testable* and *interesting*. Write it in your lab notebook along with a justification for choosing it. If you don't have any reason to choose one hypothesis over the rest, you can choose more than one!
7. Indicate whether or not you need a control group for your investigation. (Hint: A control group is a group that you do not do anything to, which is used for accurate testing and baseline comparisons.) If you do need a control group indicate what it is and why it is necessary for your investigation. If you do not need a control group, explain why one is not needed.
8. Make a list of <u>all of the variables</u> that you would want to control in this investigation. These are the variables that you want to remain constant for each experimental (treatment) group.

Example: If you are examining how the health of a milkweed plant affects the abundance of organisms, then you would want to be sure that all of your observations were conducted at similar times of day, at similar locations, under similar weather conditions, etc.

9. Examine your control variable list and explain whether or not the variable can be controlled in your investigation with the previously collected data.
10. Submit an investigation proposal. Each group (this does NOT have to be an individual effort) should submit a project proposal, which should include your question, variables (independent, dependent, and control), hypothesis, a plan indicating how you will analyze your data, a time frame for completing your project, and a blank work log that you will use to keep track of the time that each group member spends working on the project.

<u>Part 4</u>: <u>Analyze the Data & Draw Conclusions</u>

1. Retrieve the compiled milkweed community study data:

a. Go to WI Nature Mapping website: http://www.wisnatmap.org/
b. Select "Special Projects" from the top toolbar.
c. Select "Milkweed Community Study" from the list of special projects.
d. Scroll towards the bottom of the screen and find the section entitled "Get or View Data".
e. Select "Text File". This will allow you to download the data as a Microsoft Excel spreadsheet.

2. Examine the data and organize it (use the sort option) according to your research question and selected variables (i.e., delete unnecessary data columns from your spreadsheet).
3. Save your newly created spreadsheet.
4. Transform the "raw data" in your spreadsheet (e.g., calculate averages, percentages, etc.). If you are using Microsoft Excel, you can use commands to easily transform your data. (Refer to the "Help" option on the Excel's toolbar.)
5. Select the most appropriate type of format to visually display your transformed data (e.g., line graph, bar graph, pie chart, etc.).
6. Use Microsoft Excel to graph your data according to you selected format.
7. Analyze your results and draw conclusions. Discuss your results. This is where you discuss what happened in your experiment and come to a conclusion about your findings. Was your hypothesis supported by your findings or did your findings fail to support your hypothesis (refuted)? Why do you think this happened? Were their any problems with your experimental design that may have influenced your results? What could be done differently next time? Did any new questions arise? How could your results and conclusions be used?

(Special Note: Depending on your research question and the available data, you may choose to use statistics to help analyze your data. Ask your teacher for assistance with statistical analysis.)

Part 5: Present Your Investigation

Present your research findings to the class. You may select to present a poster OR a PowerPoint presentation to the class on your investigation. You will have a maximum of 15–20 minutes to present your question, hypothesis, experimental design, results, conclusions, and any future implications.

Student Assessment & Evaluation:

I use this project to primarily assess my students' understanding of the nature of science. I evaluate the projects by assigning the majority of the project points for the students' experimental designs, data analysis, and conclusions. However, I also evaluate students by assigning points for the individual field observations (see Part 1), their individual participation and contributions during in-class work time, and on their group presentations to the class.

Extensions:

1. Monarchs can be reared quite easily in the classroom. This allows students an opportunity to observe first-hand the life cycle of a butterfly. In addition, students can

use their monarchs (larvae, pupae, or butterflies) to design and conduct experiments related to questions that may arise during the rearing process. Please refer to the Monarchs in the Classroom Curriculum guide and website for additional information (http://www.monarchlab.org).

2. Students can contribute to scientific research by journaling sightings and/or tagging, recording, and releasing classroom-reared or captured wild monarch butterflies. Tagging monarch butterflies helps scientists learn more about some of the mysteries of monarch butterfly migration. Tags and tagging kits can be purchased at http://shop.monarchwatch.org/.
3. Teach students basic ecological principles using the milkweed community. Refer to the Ecology of the Milkweed Community worksheet.

(Note: I use this activity at the beginning of the ecology unit as a way to introduce relationships among organisms (e.g., trophic connections, symbiosis) and as evidence of the complex interconnections among organisms in a community.)

4. Teach students about adaptations using monarchs. Monarchs have many fascinating physical and behavioral adaptations that students can observe. These observations can allow students an opportunity to attempt to explain why these structures and behaviors aid in monarch survival. This is a great inquiry activity that can be set up as a stations lab where students move through various stations, make observations, and answer questions. Refer to the Monarch Stations Lab for an example of a stations lab that I use.
5. (Note: I use this lab activity to introduce monarch biology at the beginning of the year when students begin rearing monarchs, but I also later refer to this lab during the evolution unit.)