Insect Diversity

Grade Level: Elementary, Middle School, High School
Ecological Concepts: **Biodiversity**, **Species richness**
Arizona Science Standards: Science as Inquiry; Life Science

Materials:
1) Magnifying lenses/loupes*
2) Catch boxes*
3) White cloth
4) Forceps*
5) Writing/drawing materials
6) **Aspirator**, optional
7) **Berlese funnel**, optional
8) Sweep net
9) Field measuring tape*
10) Insect field guides*
*May be borrowed from SCENE.

BACKGROUND
Insects are six-legged **arthropods** with **exoskeletons**. They are found in almost every ecosystem worldwide. Some are **carnivores**, others **herbivores**,**omnivores**, **parasites**, or **parasitoids**. Insects occupy many **niches** and **microhabitats**. They are not always obvious, but every habitat has insects of some sort.

Insects inhabit almost all areas of the Earth. Which types and species occupy an area will vary depending on the **biotic** and **abiotic** characteristics of the habitat. Also, the number and types of insects found in a habitat change over time. Potential factors causing these changes are birth, death, **immigration**, and**emigration**. These factors in turn are influenced by what is available in the habitat for the insects to be able to live and reproduce.

GUIDED INQUIRY
Observation/Exploration Period: Examine the habitat for insects or signs of insects, or other arthropods such as spiders, mites or isopods. Signs include spider webs, cocoons, partially eaten leaves, eggs on the plant leaves or stems, **mines** on the leaf surface, **galls** on leaves or stems, holes in the ground, exoskeletons, dead insects, and insect frass (feces). Look on and under plants, inside leaves, in the air using a **sweep net**, in plant debris (leaf litter) on the ground, on fences or other structures, and in the soil itself.

Group Discussion and Question Period: Why do some plants or parts of plants have more insects than others? Why don't we see many insects on some plants? What insects are in the soil? How many different kinds of insects are in the habitat? Does time of day or year change what insects will be here? What insects are in our habitat? Do some places in the habitat have more insects than other places?

Important aspects of guided inquiry are encouraging students to generate multiple hypotheses, and letting students make decisions about what data are important and create their own data sheets. Keeping these ideas in mind, the sample in the box below illustrates how ONE OF MANY possible investigations around this topic might develop.

Sample Hypothesis: Let's use the question, "Why do some areas of the habitat have more insects than other areas?" Our hypothesis might be, "Areas of the habitat with more plants will have more insects because the food they need is there." Or, "As the amount of plant **biomass** increases, the number and types of insects will increase."

Sample Experiment Design: The original placement of plants in the schoolyard habitat was human-caused, but where insects will be found, how many, and what species are unknown until a survey is done. To get beginning, or baseline, data, we need to set up a method for collecting it. To test the hypothesis that insects prefer places with more plants, we set up an experiment to test the **independent variable** of plant **density**. The **dependent variable** is numbers/species of insects found.

Survey: Map out the habitat, drawing in the plants and any other permanent structures. Divide the habitat into sections of the same size and shape. Each area will be randomly searched for actual insects or signs of insects.

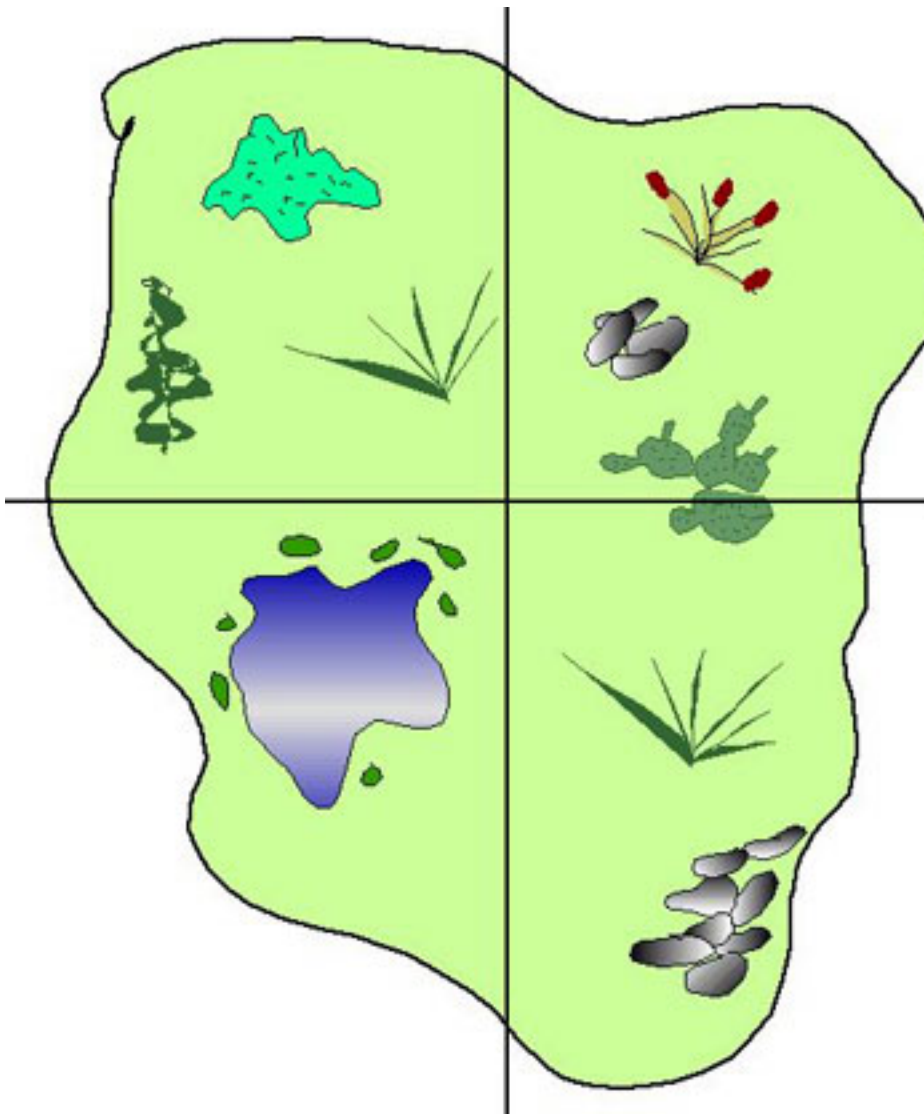

Figure 1. A habitat area divided into more or less equal sections.

Split the students into groups. Each group takes a white tray, a net, a hand lens, forceps, paper and pencil, and any other insect collecting equipment available. Each group picks an area of the habitat to search for insects and other arthropods. Look over the plants for actual insects or signs of insects. If possible, place the white tray under a section of the plant and shake it enough to shake loose some insects. Other members of the group can be using**forceps**, **aspirators**, **sieves** and **nets** to collect insects off leaves, on the ground, in the soil, and in the air. Be careful, for your safety and for that of the insects. Release insects once the data are collected.

Sample Prediction: The types and numbers of insects will be higher in areas of the habitat with more plants.

Record Results: Record the number of plants and what species they are for each section of the habitat. Categorize insects according to general body characteristics (e.g., beetles, moths, other arthropods). At this point it is not necessary to know the names of the insects. Count how many insects of each type you found.

Sample Analysis of Data and Presentation: Graph the total number of insects for each area of the habitat and the numbers of each type of insect on a **bar graph**, with plant density on the horizontal axis and insect numbers on the vertical axis.

Discussion: Was your hypothesis supported? If yes, go on to test other hypotheses. If not, why not? What did happen? Why? This is a great opportunity to revise your hypothesis and do another test.

MORE:
(1) Elementary:
(a) Use soil sieves to sort through the soil and look for insects. Count as above.
(b) Spread out leaf litter on trays and look for insects. Use a **Berlese funnel**. Count as above.

(2) Middle School:
(a) Within each habitat area **randomly** choose five smaller areas to survey for insects. Continue as above. Each smaller area is an **experimental unit**, yielding five replicates.
(b) Find the **mean**, **median**, **mode** and **range** of the replicated sub-areas of the habitat. Do this by adding the numbers from each sub-area within an area together to get a total number for the area, and then average that total number by dividing by the number of sub-areas.
(c) Categorize sub-areas of the habitat as high, medium or low plant density based upon number of plants. Compare the numbers of insects based upon the density of plants in each area. Graph plant density on the horizontal axis and insect number on the vertical axis.

(3) High School:
(a) Calculate the **variance** and **standard deviation** of the averaged data of the five sub-areas in Extension (a) above.
(b) Conduct the counts at different times of day or year. Test for a **correlation** between the two variables, number of insects and time of collection. Draw a**scatter plot** and calculate the sample **correlation coefficient**. This will yield data indicating what changes are occurring over time in the community of insects in the habitat. Map the data onto a map of the habitat.
(c) Calculate the **volume** of each plant. Measure the height, length and depth of each plant. Use the **volume** of a sphere if plant structure more closely matches a sphere shape. A volume measurement will yield an estimate of the plant **biomass** in the area. Calculating the biomass available for insects will give a more accurate representation of plant density, as compared to just counting the number of plants in the area.
(d) Calculate **species richness** of insects for each habitat area or each plant species.
(e) Do a **T-test** of species richness per plant unit volume. (T-test is a standard statistics test comparing means of two samples.)
(f) **Black light** the area at night. Collect, sort, and count the insects. Compare daytime and nighttime species richness.