Aquatic Insect Diversity

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

Materials:
1) Plankton net, optional (see directions to make, below)
2) Dip nets*
3) Plastic trays*
4) Writing/drawing materials
5) Sweep nets
6) Pipettes*
7) Forceps*
8) Field measuring tape*
9) Pond field guides*
10) Hand lenses *
*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.

Some aquatic insects spend their entire life in the water, while others spend only part of their life there, usually the **larval** stage. Most species with aquatic larvae spend their terrestrial adult stage near water, feeding, mating, and laying eggs. Aquatic insects are found on submerged plants, free in the water itself, around rocks, on and in the sediment (mud) of the body of water. In each of these **microhabitats** particular insect species will be found, filling a **niche** in the aquatic environment. Within a habitat the organism finds necessary resources such as food and safety from predators.

GUIDED INQUIRY
Observation/Exploration: Examine the water habitat for insects or signs of insects or other arthropods such as spiders, mites, or **amphipods** and **isopods**. Signs include spider webs, cocoons, eggs on the plant leaves or stems, exoskeletons, and dead insects. Look on and under plants, inside leaves, in the air using a **sweep net**, in plant debris (leaf litter) on the sediment, in the water, and in the mud.

Group Discussion and Question Period: Why do some plants or parts of plants have more insects than others? Do we see many insects out in the water? What insects are in the mud? 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 pond? Do some places in the pond have more insects than other places? What do these animals eat? Which ones live their whole life in the water? How do aquatic insects avoid predators like other insects, fish, and birds?

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: "Do some areas of the pond have more insects than other areas?" Our hypothesis could be: "As plant density increases, insect density will increase." Or, "Areas of the pond with more plants will have more insects because the food or safety they need is there."

Humans may have determined the original placement of plants in the schoolyard pond, 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. Test the hypothesis that insects prefer places with more plants by setting up an experiment in which the **independent variable** is plant density and the **dependent variable** is numbers/species of insects found.

Initial Survey: Sketch the pond, drawing in the plant locations. Divide the pond (on paper) into sections that are approximately equal in size and shape (see Figure 1. below). Use stakes or **flagging** along the edge of the pond to mark the sections after measuring with the **field measuring tape**. Each section will be searched for insects. Divide students into groups. Each group will search one section of the pond for insects and other athropods. Each group will need a white tray, a dip net, a hand lens, forceps, pipette, paper and pencil, and any other aquatic insect collecting equipment that is available. Students will search their section of the pond for aquatic insects on and around plants, in the mud, in the open water, and in the air, and record the number and types of insects found. Be careful, for your safety and for that of the insects. Keep the animals wet and release them once the data are collected.

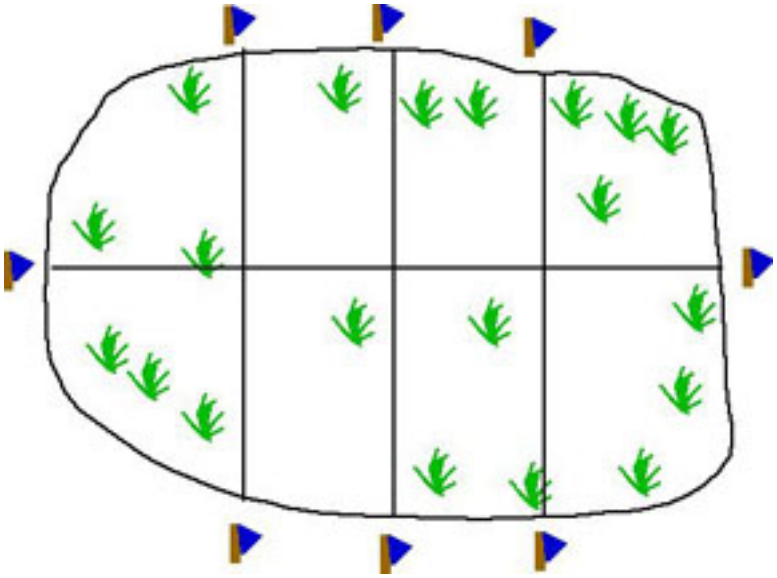

Figure 1. Diagram of pond divided into eight sections and marked with flagging.

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

Record Results: Record the number of plants and insects found in each pond section. Group insects according to general body characteristics, e.g., beetles, dragonflies, damselflies, or other arthropods. At this point it is not necessary to know the names of the insects. Count how many insects of each type were found.

Sample Analysis of Data and Presentation: Graph the total number of insects for each section of the pond, 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. Or, you can graph the total number of insects on one graph, and numbers of individual types of insects on a separate graph.

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) Middle School:
(a) Find the **mean**, **median**, **mode** and **range** of the data.
(b) Test what would happen to insect density if the types of plants were changed.
(c) Use a **plankton net** to capture **zooplankton** in the open water and near the edges. Compare the types and numbers found in the two areas, open water versus edge. Use a pond guide to identify the zooplankton.

(2) High School:
(a) Calculate the **variance** and **standard deviation** of the averaged data within the low and high plant density sections.
(b) Conduct the insect counts at different times of the year. Test for a **correlation** between the two variables, number of insects and time of year. 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. Map the data onto a diagram of the pond.
(c) Calculate **species richness** of insects for high versus low plant density sections.
(d) Do a **t-test** of species richness. (T-test is a standard statistics test comparing **means** of two samples).
(e) If the pond is uniformly dense with plants on all the edges, set up a manipulative experiment where sections of the pond are planted with more plants to increase the density. Split the pond (on paper) into eight sections. Use stakes or flagging along the edge of the pond to mark the sections after measuring with the field measuring tape. Increase the plant density in every other section to get four high-density replicates and four low-density replicates. (You might be able to just move plants around to change density. Aquatic plants are often easily moved.) Survey the sections of the pond before doing the manipulation to get baseline data. Put the plants in, give them time to take root, and time for the aquatic animals to **acclimate** to the change. Survey each section as before, trying not to be too disruptive. Depending on the shape of the bottom of the pond and the material it is made of, you may be able to temporarily place a triangle of solid walls to divide each section while surveying. This will keep animals in their respective section during the survey, resulting in a more accurate count.

All levels:
Making your own plankton nets is easy, and much cheaper than buying them from a biological supply house.

Supplies needed:

Metal or plastic embroidery hoop
Old bed sheet
Small plastic pill vial
2 pieces of strong, flexible wire, each 10 cm longer than hoop diameter
6 meters of nylon fish line
1 rubber band
To make the net: Experiment with a pattern to create one that will form a cone when one side of the cloth is sewn all the way. Sew the bed sheet cloth into a cone shape. Make the top as big around as the hoop and the other end as narrow as the pill vial opening.

Wire yoke: lay the 2 wires next to each other. Bend them in half together. Twist the two wires together in the middle to create an opening. This will be for tying the fishing line on to.

Assemble the net: Put the hoop onto the top of the net by separating the two parts of the hoop, placing the cloth over the inner hoop and the larger hoop over the cloth and inner hoop. Drop the pill vial into the bottom of the cone with the bottom of the vial coming out the opening of the cone. Secure it in place with

the rubber band over the cloth. Attach the wire in four places evenly around the large opening. Poke the wire ends through the cloth, pull through and twist back on themselves. Tie the fishing line to the loop at the top of the wires.

To use the net, throw it underhand out into the water, let it sink a little bit, and then slowly pull it back in. Hold it upright until all the water except what is in the vial has drained. Invert the net and pour the contents of the vial into a plastic cup.

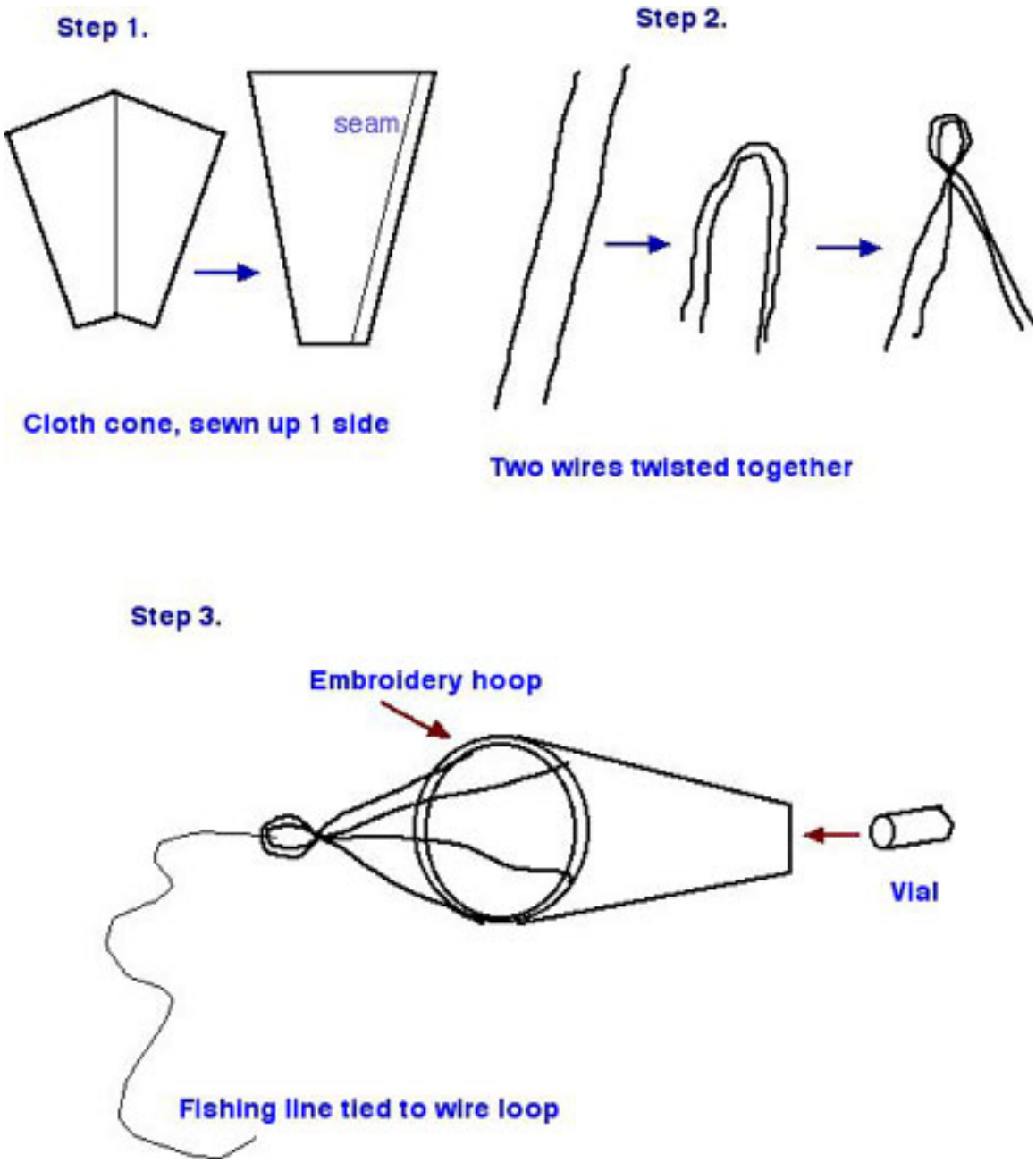

Figure 1. Assembling a plankton net.