Topic 9: Ecology – 9b. Biodiversity
9b2. Insect Collection

Resources: Campbell et al. *Biology: Exploring Life.* Prentice Hall, pp. 532-536.

Campbell et al. *Biology: Concepts and Connections*. Pearson, pp. 382-383.

Miller and Levine, *Biology.* Prentice Hall, pp. 726-733.

Building on: Ecology and evolution
Animal anatomy and physiology
Classification

Links to Chemistry: Chemistry of poisons
Phase change/volatility

Links to Physics: Aerodynamics of flight

Stories: Insect collecting is a great way to teach biodiversity. Charles Darwin was an avid collector of beetles and he brought back an amazing array from his voyage on the HMS *Beagle*. Insects contain by far the greatest variety of species, most of which is concentrated in the tropical rainforest. In fact, one scientific study found that only one out of every 20 insects in the rainforest has been named and classified, leading scientists to conclude that there may be as many as 19 million unnamed insect species to go along with the one million that we have classified!

Lab Instructions and Materials for the Teacher:

Biological supply companies can supply you with insect pins and nets. There are even specialty items to help spread butterfly wings. Ethyl acetate is also available for sale, but this lab uses mostly household items, which is nice. I try to focus on biodiversity in getting the students to collect as many **different** insect species as possible. I then have them try to sort their insects into the proper order; this is a great introduction for classification later. Collecting in cold weather regions is probably done better in the fall than the spring, when the insects are most active.

More and more often, I hear objections to insect collecting on ecological or religious grounds. I try to be sensitive to this by allowing students to work in partners (one partner can collect and pin while the other will classify), and this satisfies many of them. While I doubt that 100 students collecting 15 insects will have much of an environmental impact, I tell my students that these insects will be maintained for posterity, rather than dying in obscurity as winter sets in! If there are still objections, I will allow students to complete an "alternative collection" in which they may bring in live specimens—labeled and classified—that they later release, or else a video collection in which they photograph or videotape the insects in

nature. NOTE: If they do the video collection, they must somehow document that the video clip or photograph is their own and not downloaded from the Internet!

Preparing an Insect Collection

Insects are a class of animals in the Phylum Arthropoda. Some scientists estimate that there might be more than 10,000,000 species of insects on Earth, although only 750,000 have been classified. Insects are important not just because there are so many of them, but also because they are responsible for pollination of flowers and for production of honey, wax, and silk. They also consume 13 percent of our food crops and are responsible for transmitting organisms that cause many human diseases. Because they are so important to our lives and they are so abundant, insects are excellent organisms for study.

Objectives:

- Collect and prepare an insect collection.
- Recognize and become familiar with the features used to identify insects.

Materials:

Scissors	White index cards (underlined) (2)	Plastic film canister	Clean glass jars (approx. 1-L size) with lids (2)
White glue	Facial tissue (4)	Moth balls (crystals)	Polystyrene foam pieces (25 cm x 25 cm x 3 cm) (2)
White paper	Insect net (optional)	95% ethanol	Wax marking pencil
#2 insect pins (23-30)	Masking tape	10x hand lens	Small cardboard boxes (approx. 6)
Fingernail polish remover (ethyl acetate)	Cardboard display box	Small vials (50 ml) w/stoppers	

Procedure:

Part A. Collecting Insects

1. Reinforce the two jars with masking tape.
2. Label both jars with a wax marking pencil, "POISON." On one write "BUTTERFLIES AND MOTHS" and on the other, write "GENERAL." The jar for butterflies and moths will prevent these delicate insects from being damaged by other, tougher insects.
3. Place two pieces of crumpled tissue in each jar. These jars will serve as chambers for killing the insects.
4. Place one capful, approximately 5-10 ml, of fingernail polish remover on the tissues in the jars when ready to collect insects. The liquid will be effective for a few hours of collecting. Keep lids tightly on the jars except when placing insects in them.
5. Collect 15 different types of insects from several different habitats. Look under stones, boards, loose board, shrubs and leaves, inside flowers, and around windows. Flying insects can be collected using an insect net around vegetation during the day or around lights at night. As you collect the insects, write a brief description of the insect, habitat, date, and time of day. This information will help you prepare labels when you return to the lab.
6. Place each insect in the appropriate jar for at least one hour.
7. Place the insects, once they are dead, in small cardboard boxes to hold until pinning. Label the boxes with your name. DO NOT place insects in plastic boxes or they will mold before being pinned.

Part B. Preparing Insects

Pin insects within 48 hours of their collection.

1. Prepare a label for each insect. Include the following information on each label:
   - State, County
   - City, Location
   - Date, Time of Day Collected
   - Your Name

Standard Insects

2. Place an insect pin through the thorax so that it runs from the dorsal side to the ventral side. Place the insect on the upper one-third of the pin. About one-fourth of the top of the pin should be exposed so that all insects are at the same level in the box. Make sure the insect is level on its pin. It should not be tilted in any direction.
3. Pin each insect's label under the insect.
4. Place the pinned insect onto a piece of polystyrene foam.

Small Insects

5. Cut a very small triangle from an index card.
6. Place a small dab of glue on the point of the tab. Approach the right side of the insect's thorax with the tab, touching the insect so that it attaches to the tab. After the glue dries, run an insect pin through the tab.

Moths and Butterflies

Moths and butterflies need special care. After they have been pinned, their wings must be spread and allowed to dry in place.

7. With the point of the scissors, dig a small depression or "ditch" about 3 cm long and 1 cm wide in a piece of polystyrene foam. The size of the body of the insect will determine the size of the depression.
8. Pin the insect body according to steps 1-4 and place it in the depression so that the wings are even with the flat surface of the polystyrene foam.
9. Cut two small strips of the index card and pin one end of each strip over the wings.
10. Position the wings on the right side as shown and pin down the other end of the strip with a second pin. Repeat this procedure with the wings on the left side.
11. Allow the moth or butterfly to dry for at least two days.
12. After the insect is dry, carefully remove the paper strips. Handle these fragile insects gently, touching only their pins.

Aquatic Insects

13. Place each aquatic insect directly into a small vial half filled with ethanol. Use pencil to fill out the label because many inks will wash away in the alcohol. Place the insect label into the vial with the insect. Seal the vials with liquid-tight lids.

Part C. Preparing a Display Box

14. Cut a piece of polystyrene foam so that it fits the bottom of your display box tightly. Place it in the box.

15. Pin the insects in the foam. Insects in vials can be placed in holes in the foam or held in place by tape.
16. Place an uncapped plastic film canister in the corner of the box and fill it with moth crystals.
17. Using a hand lens, study the external features of your insects. Answer the questions in Data and Observations.
18. Complete this lab and then store the collection for later use.

Data and Observations:

1. List at least three observable features that all of your insects share.

2. List the different types of insect mouthparts that occur in your collection.

3. List the different types of appendages found at the end of your insects' abdomens.

Analysis:

1. Of the insects that have wings, how do the wings differ?

2. Do all of your insects have antennae? How do your insects' antennae differ?

3. Which of the observable features of your insects could be used to separate them into different groups?

4. Would it be a good idea to classify insects based upon an insect's habitat? Why or why not?

Insect Orders

Orthoptera (grasshoppers, roaches, and their kin): Medium to large insects. Live on land. Forewings feathery. Hindwings folded fan-like (some have no wings). Development gradual. Chewing mouthparts.

Dermaptera (earwings): Small insects with typical pincer-like tail. Usually four small wings. Segmented antennae. Development gradual.

Isoptera (termites): Ant-like insects, small and soft-bodies. Some have four long wings. Live in colonites. Specialized "casts" for working, fighting. Chewing mouthparts. Development gradual.

Anoplura (lice): Small, wingless insects with piercing and sucking mouthparts. Body flattened. Legs with claws for clinging to warm-blooded animals.

Homoptera (leafhoppers, aphids, and scale insects): Small to medium insects, most with two pairs of similar wings held sloping at sides of body. Jointed beak for sucking attached to base of head. Land insects. Some scale-like.

Hemiptera (true bugs): Range from small to large in size. Two pairs of wings, with forewings partly thickened. Jointed beak for sucking arises from front of head. Development gradual.

Odonata (dragonflies and their kin): Fairly large insects with two pairs of long, equal-sized wings. Body long and slender. Antennae short. Immature insects are aquatic. Development in three stages.

Ephemerida (mayflies) / **Plecoptera** (stoneflies): Both with two pairs of transparent, veined wings. In mayflies, hind wings are smaller; in stoneflies, they are larger. Mayflies have long, two- or three-pronged tails.

Neuroptera (nerve-winged insects): The two pairs of wings, usually equal in size, are netted with veins. Four stages of development: egg, larva, pupa, and adult. Chewing mouthparts. Long antennae.

Mecoptera (scorpionflies): Small insects with two pairs of slender, generally spotted wings. Legs long. Antennae long also. Beak-like, chewing mouthparts. Larvae live in soil.

Trichoptera (caddisflies): Most larvae live in fresh water. Some build ornamented case. Adults with two pairs of wings with long, silky hairs and with long antennae. Mouthparts reduced.

Lepidoptera (butterflies and moths): Medium to large insects with two pairs of scaly wings. Sucking mouthparts. Antennae knob-like or feathery. Development in four stages.

Diptera (flies and their kin): Two-winged, small to medium insects, with sucking mouthparts. Antennae small; eyes large. Second pair of wings reduced to balancing organs. Development in four stages.

Coleoptera (beetles): Forewings modified to thickened covers. Hind wings thin, folded. Size from small to large. Chewing mouthparts. Antennae usually short. All have four life stages; some aquatic.

Hymenoptera (bees, wasps, and ants): Small to medium-sized insects; many social or colonial. Two pairs of thin, transparent wings. Hind wings smaller. Mouthparts for chewing or sucking. Only insects with “stingers.” Development in four stages.