EVENING SPIDER/INSECT COLLECTION

LESSON LENGTH:
- 1 hour

GOALS:
- Learn how to collect and identify insects and spiders (invertebrates), and understand why many are nocturnal

OBJECTIVES:
Students will be able to:
- Explain why some invertebrates are nocturnal
- Survey an area for invertebrates (species and number)

STUDENT TAKEAWAYS FROM LESSON:
- Essential question / theme
  - What type of invertebrates live in the forest, why are they important to ecosystems and people, and why do they come out at night?
- Key concepts and vocabulary
  - **Transect:** a straight line or narrow section through an object or natural feature or across the earth's surface, along which observations are made or measurements taken.)
  - **Nocturnal / diurnal / crepuscular:** being active primarily at night, during the day, and at twilight (dawn/dusk), respectively
  - **Phototaxis:** how organisms respond to light with motion

ASSESSMENTS:
- Data recording in journal
- Discussion

MATERIALS & EQUIPMENT:
- Bug spray
- Headlamps
- Paper
- Tape measure
- Hand lens
- Journals, pencils
- Digging tools

LOCATION:
- This lesson should be done near a stream.

RISK MANAGEMENT & SAFETY CONCERNS:
- Girls will be working in the dark
- Make sure girls feel safe while working with insects and spiders.
- Digging tools can be dangerous.

PRE-LESSON PREPARATION:
- The outdoor exploration can be skipped, and this entire activity can be done under a tarp or in tents.

LESSON:

ENGAGE

- This should be done in the dark (with headlamps) wearing shoes that can get wet and bug spray.
- Ask students:
    - *How do you feel about bugs and spiders? Why do you feel that way?*
    - *Is a spider an insect?* (No! Insects have 6 legs, spiders have 8.)
    - *Why are insects and spiders important to an ecosystem?*
        - Insects have adapted to a broad range of habitats, successfully finding their own niche because they will eat almost any substance that has nutritional value. Insects are crucial components of many ecosystems, where they perform many important functions. They aerate the soil, pollinate blossoms, and control insect and plant pests. Many insects, especially beetles, are scavengers, feeding on dead animals and fallen trees, thereby recycling nutrients back into the soil. As decomposers, insects help create top soil, the nutrient-rich layer of soil that helps plants grow. Burrowing bugs such as ants and beetles dig tunnels that provide channels for water, benefiting plants. Bees, wasps, butterflies, and ants pollinate flowering plants. All insects fertilize the soil with the nutrients from their droppings. Insects are sources of food for other animals in the ecosystem.
        - Spiders, on the other hand, have one main role in almost every ecosystem: keeping the insect population under control. It is estimated that one spider can eat as many as 2,000 insects in a year. The magnitude of an 'insect apocalypse' that could occur without spiders to help keep the numbers down isn't quite clear but would be devastating to the entire ecosystem. Both flora and fauna would be affected drastically if we were to take spiders out of the equation. Spiders are in turn food for other organisms, from other spiders to birds, reptiles, and small mammals like shrews.
    - *Why are insects and spiders important to people?*
        - Insects fertilize and pollinate our crops, and some insects produce useful substances, such as honey, wax, lacquer, and silk. Honeybees have been raised by humans for thousands of years for honey. The silkworm greatly affected human history. When the Chinese used worms to develop silk, the silk trade connected China to the rest of the world. Adult insects, such as crickets, as well as insect larvae, are also commonly used as fishing bait. Insects are sources of food for people in certain parts of the world, too: insects are a rich source of protein, vitamins, and minerals. In fact, it is difficult to find an insect that is not eaten in one form or another by people. Among the most popular are cicadas, locusts, mantises, grubs, caterpillars, crickets, ants, and wasps. Many people support this idea to provide a source of protein in human nutrition.
        - Spiders keep the ecosystems where our crops grow in balance by consuming agricultural pests—including aphids, grasshoppers, leafhoppers, beetles, and caterpillars—that feed on the fruits, leaves, stems, and seeds of crops that we harvest for food. Reductions in pest

abundance by spiders have led to decreased crop damage, which can help increase yields. Spiders are also very important in keeping harmful bugs like biting flies and mosquitos to a minimum, making them less likely to spread disease (malaria, Zika, etc.). Spider venoms show promise in the field of medicine. Spider silk is among the strongest, most elastic of natural fibers. Synthesized spider silk has proven useful in creating the next generation of parachutes and bullet-proof vests. Native peoples in Papua New Guinea even use the webs of Nephila orb-weaving spiders as fishing nets. The spider is coaxed into spinning within an oval frame that is then used as a net. Spiders are also used as research subjects in such diverse disciplines as animal physiology and psychology.

- *Are bugs and spiders invertebrates or vertebrates?* (invertebrates. Explain that we're going to be calling the spiders and insects that we see in the forest "invertebrates.")
- *What time of day do you see more invertebrates in the forest? What about in your city/community?* (Answers may very – ask for specific types of invertebrates, like mosquitos (which are crepuscular/nocturnal) and bees, which are diurnal. Most spiders are nocturnal. Ask for/explain definitions of nocturnal, diurnal, and crepuscular.)
- *We're going to collect and identify some invertebrates tonight; what types of invertebrates will we most likely find?* (nocturnal).
- *How do invertebrates behave around an artificial light at night?* (Have students look at the behavior of insects around their headlamps or think about how different insects (i.e. moths and roaches) behave differently around light. Joke: How many cockroaches does it take to screw in a lightbulb? Can't tell; when the light comes on, they scatter!)

EXPLAIN

- Bring the groups back together and facilitate a discussion by asking the following the questions:
  - *How close were you to your prediction?*
  - *Which group found more invertebrates? Why do you think one environment was better than another?*
  - *Was there a specific part of each transect where there were more inverts than others?*
  - *What surprised you during this activity?*
  - *Do you think these results would change with season? Why/why not?*
  - *Why did we do this near a stream?*
    - *It's more damp – they need water.*
    - *There may be more prey in these moist soils.*
    - *They might not be able to sense us as well (hearing, possibly vibrations in ground from stream).*
  - *Why did we do this in the dark?*
    - *Quite a few invertebrates are nocturnal and only come out at night. Daytime is hot and full of predators and competitors like birds. Granted, the night is cold and full of bats, but nocturnal invertebrates prefer the latter.*

- *Another part of this is that we are more likely to see flying insects at night because some of them fly to our lights. A phenomenon called phototaxis explains how organisms respond to light with motion. Insects, such as moths, that move toward lights are considered positively phototactic. Other insects, such as cockroaches, that move away from lights are considered negatively phototactic.*
- *Scientists aren't positive about why positively phototactic insects are attracted to lights, but they have theories. One of the most popular theories holds that positively phototactic insects are drawn to lights because they act like a navigational guide. Many insects find their way by keeping a natural light source, such as the sun or the moon, at a constant angle.*
- *Unfortunately, when they encounter an artificial light, insects can become confused very easily. They may mistake the artificial light as the sun or the moon. Rather than keeping a constant angle with the sun or the moon, these insects instead begin to try to keep the artificial light at a constant angle. Since the artificial light radiates light in all directions, however, insects can't keep the light at a constant angle. The usual result is that the insects will circle around and around the artificial light.*
- *Scientists have also come up with a variety of other ideas that might explain insects' light-loving behavior. For example, some scientists believe artificial lights merely light a clear path for insects to follow. Rather than flying around in the dark trying to avoid obstacles, they instead head directly for lights because they can see that the path is clear.*
- *Other scientists believe some insects may mistake artificial lights for flowers. How can that be? Scientists know that some flowers reflect ultraviolet light. To the extent that a particular artificial light also emits a small bit of ultraviolet light, some insects may mistake it for a flower, thinking it's a source of food!*

- *What types of scientists do these types of surveys? What information does this tell us about the ecosystem?*
  - *Tells us about health of the ecosystem (in general, the more biodiverse, the healthier the ecosystem)*
  - *Tells us about species abundance, biodiversity, and which species are found in which ecosystems.*