Lesson: Mini-ATBI

Grade Level:
5th - 8th grade

Subject Areas: Earth Science

Activity time: 1 class period to design study, 1 class period to conduct ATBI, 1 class period to discuss results

Setting: outdoors, discussion indoors

Skills: Gathering information through observing, collecting and recording; Organizing information through classifying; Drawing; Analyzing information.

Vocabulary:
- **Biological inventory**: a list of all species found within a given area.
- **Biological monitoring**: usually set up for a specific problem or issue. Consist sof a series of inventories set up over time to better understand how species interact in their habitat.
- **Ecosystem**: all living organisms in a certain area as well as their physical environment.
- **Niche:** the role of an organism in its ecosystem.
- **Scientific nomenclature**: the way we name things in science. Based on evolutionary relationships.
- **Taxonomy**: the science of systematically naming and recording species.

Objectives: Students will:
1) develop an inventory of the species within a defined area;
2) explain how at least two of the species they found depend on one another.
3) describe a factor that could change the diversity found in their plot.

National Standards:
- Content Standard A: Science as Inquiry;
- Content Standard C: Life Science;
- Content Standard E: Science and Technology;
- Content Standard F: Science in Personal and Social Perspectives;
- Content Standard G: History and Nature of Science

Materials:
- Data sheet (see below)
- Field guides for the area
- Hula hoops or similarly sized circles of string
- Collecting equipment that may include sifter boxes (see instructions following this lesson), beat sheets, nets, aspirators
- Collecting boxes to hold insects

Background:
The modern classification system that we use is based on the work of Carolus Linnaeus. Organisms are placed in increasingly specific groupings starting at the most broad level called “Kingdom” and moving down in the following order: “Phylum”, “Class”, “Order”, “Family”, “Genus”, “Species”. All living things have an offical name, comprised of a genus name and a species name. Having a universal system of naming things allows scientists around the world to speak the same language when discussing living things. Many species also have common names which are specific to a region. These can be confusing since one region may call the same organism a different name than another region.

In a park, it is important to develop an understanding of not only the species you are trying to protect but how they interact with one another. In the Great Smoky Mountains National Park, the All Taxa Biodiversity Inventory (ATBI) is an effort to identify and understand the ecological niche of all species in the Park. This is important so park managers can make informed decisions on how to best protect park resources. Imagine trying to fix a car engine when you only know 10% of the parts and how they work together. That is in essence what many managers of natural systems are trying to do. An ATBI is an effort to increase knowledge so you can do a better job of managing species in a complex environment that includes issues like exotic invasive species, climate change, impacts from air and water pollution and other threats.

Introduction:
Select a study site with multiple habitat types, such as old field (native or non-native plants), second growth forest, mature forest (softwood, cove hardwood, mixed oak/pine, etc.), lawn, stream bank, rocky outcrop, old building, etc. For most groups it would be easiest to designate two habitat types that are obviously different, such as a forest and a field. If done at a

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school, a weedy area and an area with trees could be compared, or a trip to a nearby park, if there is one, could be made.

Explain to the students that they are going to participate in a biological inventory (see vocabulary). Ask them why it might be important to know what types of plants and animals are in an area (*some are sensitive to change and can indicate a problem in the ecosystem*).

Other introductory information should include a discussion of what biodiversity is and why it is important. You can introduce the All Taxa Biodiversity Inventory either before or after the activity. Have the students develop a list of factors that might affect the biodiversity of an area (climate, disturbance, habitat, etc.).

Procedure:

1: Design a research study question, one possibility is "How does habitat affect biodiversity?". We are interested in comparing the overall number of species in different habitats, as well as comparing the diversity of different groups of species (plants vs. invertebrates vs. vertebrates vs. fungi, etc.).

2: Have the students develop appropriate hypotheses and list their hypotheses and predictions. Hypotheses are the possible outcomes to an experiment, including the possibility of no difference (null hypothesis). A prediction is an educated guess about the outcome of the experiment—what you think will happen. The null hypothesis here is that there will be no difference in the biodiversity of the habitats. Alternative hypotheses include that one habitat is more diverse than the others.

3: Have the students predict total numbers of species living in each habitat, and predict what groups of species will be most diverse.

4: Ask students to think about how we would go about testing our hypotheses. (*Their answers should include something about taking an inventory of the habitat.*)

Ask students "What type of controls do we need in our study?" Answers should include...

- *Limiting the area searched to a unit of ground the same size for each habitat (if the different habitat types cover significantly different areas, the larger area could be expected to hold more species; using study plots of the same size allows us to ask if the different habitats would have different numbers of species regardless of their acreage).*
- *Use the same sampling techniques for each habitat (can't do this if comparing aquatic and terrestrial habitats).*
- *Sample each habitat using the same equipment, for the same length of time and with the same number of people.*

5: Show and demonstrate to students how they will use any collecting equipment. Also show them any field guides available for their use.

6: Go over the data sheet point system. The more specific they are with ID, the more points they get for their group.

7: Have the students break into two groups, and assign each group to a habitat. Break each group into subgroups of 4-5 students. Each of those groups will randomly toss their hula hoop into their designated habitat.

8: Have students do a timed search (10 - 15 minutes) with all groups starting at the same time, completing their datasheet as they collect.

9: At the end of the time allotted, bring them back together. What did each group find? Which group found more species? Tally what each group found onto a big piece of paper (flip chart) and figure out which species were found in both habitats, which species were found only in one or another. Which species were most common in each habitat? Which taxa were most common? What does the data say about their hypotheses? If you want to emphasize the competitive aspects of the activity, tally points for each recorded observation.

Wrap Up: After analyzing the data, analyze the methods. What worked and what didn't? Have them set up a protocol (methods; "rules") for how to do this study and then put the different steps in order. Some of the ideas they could come up with include:

- choose a leader;
- look over the habitat first to find a good site;
- select specialists (or give everyone a job);
- don't trample the plot before staking it out;

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• use some of the tools and not others, etc.

Why do scientists use protocols?
• To make the work go better based on knowledge from experts or past experience;
• To make it possible to duplicate the study;
• To make it possible to compare different sites because they were both studied the same way with the same protocols.

If time, have the students switch habitats and do the study again, this time following their improved protocols. This is how scientists usually do studies, first they do a field test and then they refine and implement.

Assessment:
Pre and post activity: Have the students brainstorm everything they know about biodiversity and compare before and after the activity. Have them think about what biodiversity is, why it is important and what are some threats to biodiversity.

Extension Activities:
• Conduct another mini-ATBI in a different habitat and compare the findings.
• Research whether there are any species in your area that are sensitive to change, these are called bioindicators. Some live in stream systems (like the larvae for Mayflies, Stoneflies and Caddisflies).

Resources:
ATBI website:
http://www.dlia.org/

Internet databases:
https://handsontheland.org/environmental-monitoring/terrestrial-invertebrate-study.html

Guide to Insect Orders:
https://handsontheland.org/monitoring/projects/inverts/order_guide.pdf

Guide to Spider Families:
https://handsontheland.org/monitoring/projects/inverts/common_spider_fam_GSMNP.pdf

Webpages for Insect Identification:
http://www.insectidentification.org/
http://bugguide.net/node/view/15740

Tree ID:
many states have online guides through their extension offices.
http://www.realtimerendering.com/trees/trees.html

Plant ID:
East Coast - http://www.realtimerendering.com/flowers/flowers.html
West Coast - http://www.renyswildflowers.com/view.html#vs=5

Bird ID:
https://www.allaboutbirds.org/news/
http://www.realtimerendering.com/birds/birds.html

searching for LIFE in Great Smoky Mountains National Park smokieee's

Mini-ATBI Datasheet

Team Members _____ Date_____

	Name	What is it? plant vertebrate animal fungus/lichen insect other arthropod gastropod(snails, slugs...) other invertebrate other	Points +1 for a made-up name, +2 for a general name (such as fern, crab spider, beetle, sparrow) +3 for a specific common name (such as Christmas fern, black widow spider, chipping sparrow) +4 for a scientific name
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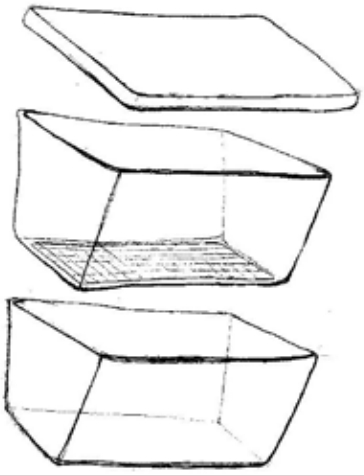
Make Your Own Field Sifter (a.k.a. Shaker Box)

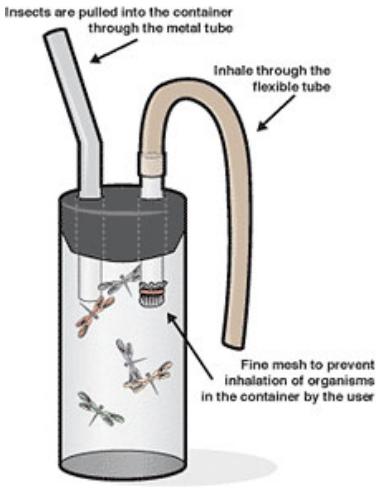
MATERIALS:
- 2 Plastic shoe boxes with 1 lid
- Wire mesh (1/4 inch hardware cloth) or roll of "Gutter Guard" (plastic mesh used for rain gutters)
- Hot glue and glue gun
- Tin shears or wire cutters

DIRECTIONS:
1. Place the plastic shoe box on top of the piece of wire mesh and mark on the mesh the perimeter of the container.
2. Cut out the pattern on the wire mesh approximately ¼ inch smaller than the actual pattern marked on the wire so it will fit snugly in the bottom of the shoe box.
3. Cut out the bottom of the shoe box leaving an inward lip of the bottom approx. ½ inch wide to attach and support the mesh on the inside of the box.
4. Apply a generous amount of hot glue around the inside of the box bottom on top of the inner lip and on the edges of the wire mesh. Allow to dry.



A completed "Shaker Box"

FIELD DIRECTIONS:
1. To use your box, put the mesh bottom box inside the shoe box that hasn't been altered. Take the two boxes into the field and making sure the mesh bottom is the box on top, fill it about halfway full with leaves and topsoil.
2. Put one of the lids on the mesh bottom box and with the two boxes still together, shake the entire unit for about 15 seconds. If the boxes fit together snuggly, keep about a 1 inch space between the two boxes when you shake. Often people will use their thumbs to hold down the lid, their first two fingers as spacers and the last two fingers of each hand to hold the bottom box.
3. Take the mesh bottom box off and search through the debris in the bottom of the complete box for anything that moves. Use an aspirator to collect the invertebrates. To see what an aspirator is and how to use it, go to the following website - http://www.handsontheland.org/monitoring/projects/inverts/terrestrial_invertebrates.cfm
4. Use the "Guide to Insect Orders" to try to identify what you find available as a PDF on the website http://www.handsontheland.org/monitoring/projects/inverts/search.cfm



An aspirator is used to collect small invertebrates in a way that doesn't harm them.