Biodiversity Blitz Outline

Big Idea

All Taxa Biodiversity Inventory (ATBI) research can be used to understand the interactions between plants and animals and is important in understanding and managing biodiversity in an area like Great Smoky Mountains Institute at Tremont (GSMNP).

Essential Questions

- How does habitat affect biodiversity?
- Why is scientific research being done in GSMNP?
- Who can do scientific research in GSMNP?
- How is the scientific method being used in the ATBI?

Vocabulary

- Animalia—multicelluar organisms that are capable of locomotion and rely on other organisms for nourishment.
- Archaea—microbes that can live in extreme environments like our stomachs, volcanoes, boiling water, or extremely salty environments. Absorbs carbon dioxide, nitrogen, and hydrogen sulfide.
- Arthropods—a large group of invertebrate animals that includes spiders, crustaceans, and their relatives
- Aspirator—instrument for catching small invertebrates through suction
- Aquatic—living in water
- Biodiversity—the variety of living organisms on earth. Often a measure of the health of an ecosystem.
- Data—information
- Fungi—multicelluar organism that cannot undergo photosynthesis for nourishment but absorbs nourishment from what it is living on.
- Habitat—the area or environment where an organism or ecological community normally lives or occurs
- Insects—any of numerous usually small arthropod animals of the class insecta, having an adult stage characterized by three pairs of legs and a body segmented into head, thorax, and abdomen, and usually having two pairs of wings. Insects include flies, crickets, mosquitoes, beetles, butterflies, and bees.
- Inventory—to list, to catalog
- Invertebrate—animals without a backbone
- Kingdom—the largest group into which living things can be classified
- Monera—one celled organisms that have no nucleus ex: bacteria

- Plantae—includes trees, non-woody plants (grasses, flowers, etc.), shrubs, ferns, vines, and mosses. Plants are multicelluar and carry out photosynthesis.
- Protist—one-celled organisms that contain a nucleus (e.g. Algae)
- Taxa—referring to taxonomic group of any kind
- Terrestrial—living on land
- Vertebrate—animals with a backbone

Lesson Outline

- Introduction—Getting Ready
- Study Site
- Equipment
- Lead In
- Procedures
- Hypotheses
- Methods
- Data Collection and Analysis
- Follow-Up Study
- Conclusion: Create a Creature

INTRODUCTION: GETTING READY

30 Minutes

Study Site: An area with multiple habitat types, such as an 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 school, a weedy area and an area with trees could be compared, or a trip to a park could be made.)

Equipment:

- String and stakes or other plot markers
- Aspirators
- Tweezers and jars
- Beat sheets
- Leaf-litter shakers
- Sweep nets
- Aerial nets
- Paper and pencils
- Clipboards and data sheets
- Flip chart or board to tally observations
- Optional: simple keys to insect orders, etc.
- Optional: aquatic dip nets, pans, seines, etc.

Lead In

The All Taxa Biodiversity Inventory (ATBI) is an effort to discover every species living in Great Smoky Mountains National Park. Discover Life In America (DLIA) is a non-profit organization whose sole purpose is to coordinate this effort. In this lesson students will be conducting a miniature All Taxa Biodiversity Inventory. They will compare the diversity of species in small plots located in different habitats. Students will attempt to determine the comparative taxa diversity of several different types of habitat while learning about inventory methodology and design, hypothesis testing, use of scientific field equipment, and the diversity of life forms that live around them. Discuss with the students why this sort of work is important (i.e. gives us a base line for what is here so changes in biodiversity can be tracked as the environment changes, global climate change, acid deposition).

Our research question for this activity 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.).

Procedures

Hypotheses: 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.

- Have the students develop and list appropriate hypotheses and predictions.
- Have the students predict total numbers of species living in each habitat, and predict what groups of species will be most diverse.

Methods: 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.

How could we test it in the next couple hours? 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.)
- Sample a few ways the same for each habitat. (Can't do this if comparing aquatic and terrestrial habitats).
- We're limited by time, time of day, and available equipment.

How do we identify what we find? For field work, one hour in the field generally requires 4-10 hours of sorting, processing, identifying, and cataloguing. We may not have the equipment to identify (or even see) bacteria and other microscopic organisms. It might take too long or be beyond our skill level to identify everything to species. We may be able to use a simple key to identify something as a "beetle," but there are thousands of beetle species in North America.

What would a scientist do if they found a new species? They would give it a name and describe it in such a way that anyone else who found it could identify it with that description or identify it as something new. Describe color, shape, pattern, behavior, and draw a picture if you think it will help. (e.g. “yellow and black striped beetle with long antennae” or “star-shaped leaf; see attached drawing.”)

Wrap Up

Now that we have asked our question and made our hypotheses, it’s time to conduct our study!

DATA COLLECTION AND ANALYSIS

90 Minutes

Lead In

Demonstrate the use of the available equipment. Introduce the group to the study area.

Procedures

- Have the students break into two groups, and assign each group to a habitat. If working with an especially large group, have them divide farther and do two study plots in each habitat or add more habitats.
- Have them pick a part of their habitat to be their study plot and mark off a roughly square or rectangular plot, 3-5 meters on a side, with stakes in the corners and string running around the outside to show the boundary. Scientists might take pains to insure that the plot is precisely square using a compass, but staking out the plot will probably be the most time-consuming and “boring” part of this exercise and should not be dwelt upon anymore than is necessary to ensure they learn that a lot of science is set-up.
- Tell them what you want is a list of all of the “species” of living organisms found in their study plots, with unfamiliar “species” named and described. Set them to work doing the inventory. Give them about 30-45 minutes.
- Remind students that science should not result in a complete destruction of habitat, if possible. The students should be sure to put rocks back in their original locations, cover soil back up with leaf litter, and return all insects to the plot by the end of the activity. Consider deducting “points” for students failing to show good stewardship and cooperation.
- You may or may not want to build up the competition aspect of this exercise (who can find more species), depending on what motivates the group. The most important thing is to conduct a thorough and complete inventory of everything they can find. We’re testing the hypotheses that the group came up with during the introduction.

Wrap Up

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 and which species 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 (see attached data sheet).

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 may 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

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.

FOLLOW-UP STUDY

30 Minutes

Lead In

The first effort was a 'pilot study:' a quick and messy attempt to collect data, generate a protocol, and improve the hypotheses. Scientists often do a pilot study, especially before spending several years on a research project. It helps reduce the chance that they have to start the whole study over again much later.

Procedures

Have the groups switch habitats and, using the protocols they designed, inventory a new plot in each habitat.

- Do the results come out the same?
- Were any new species found?
- Were the hypotheses supported or contradicted? How far off were they?

- What groups (taxa) were most common in their study plot? Which groups least common?
- What parts of their plots (microhabitats) had the most species and which the fewest?
- Discuss habitat differences and come up with ideas for why their results were what they were.
- Where could they look for species they missed (in the tree tops, in the soils, different seasons, at night, etc.)?
- Did the study work better now that they have the protocol and some experience?
- Which methods worked for them and which did not?
- How would they redesign this experiment if they could?
- The ATBI is scheduled for completion in 10 years. How realistic do they find this time frame?

Wrap Up

Rank the 10 most abundant species, based on their seat-of-the-pants guesses. Note which species they found only one of. Why do they think some of these species were very abundant and some represented by only one? This can lead to a discussion of species abundance curves, species/area relationships, rareness, extinction, reserve design, etc. How could they design this experiment so they could make a graph of species ranked by their abundance?
Also, groups that want to go more in depth and emphasize the competitive aspects of the activity can assign points to each species, depending on the level of identification provided (see attached sheet).

CONCLUSION: CREATE A CREATURE

30 Minutes

Lead In

Explain that they must draw a creature using their imagination that would live in one of the habitats studied today.

Procedures

Students are to create their own creature and adapt it for a specified habitat. They should also name their creature. Ask the students to keep a few questions in mind as they design their creatures:

- What kind of food does the creature eat, and how is it adapted for gathering and eating that food?
- How does the creature move around?
- How does the creature defend itself and avoid predators?

- Is the creature an herbivore, carnivore, or a decomposer/scavenger?

Pass out drawing paper and crayons. (If you prefer that they keep their drawings, have them use their notebooks instead.) Give students 15 minutes to complete their drawings. Students may use the Create a Critter Scientific Name Sheet to help with naming their creature.

Wrap Up

Call students back together and ask each to share his or her creature. Encourage and support every student. Every adaptation is valid, as long as it helps the creature in some way.

ATBI FIELD NOTES

Date ______/______/______ Time __________ am/pm (please circle)

LOCATION

GPS coordinates ____________________

Elevation ___________________________

Trail/specific location name _________

____

County ________________ State ______

Watershed ___________________________

____

Temperature __________ C

Precipitation Type ______________

Wind (please circle)

calm light gusty strong

Cloud cover estimation ________%

Geologic features (include soil type if known)

Nearest water source (stream, lake, pond, etc.)

Habitat Description

Type of forest or natural community (please circle)

Cove Forest	Spruce/Fir	Northern Hardwood	Pine-Heath
Mixed Hardwood	Grassy Bald	Xeric Oak/Pine	Heath Bald

Other ____

Dominant plant secies in each forest layer:

Canopy ________________________________ Sub-canopy _________________________

Shrub _________________________________ Herbaceous _________________________

General Commentary

*phenological events (migrations, plants blooming, etc.), observations, and unusual activity*Biodiversity Challenge

Biodiversity Challenge

Team Members ____ Date________________

	Name	What is it? plant vertebrate animal fungus/lichen insect other arthropod gastropod other invertebrate other	Points +1 for a made-up name +2 for a general names (such as fern, crab spider, beetle, sparrow) +3 for s specific common name (such as Christmas fern, black widow spider, milkweed beetle, chipping sparrow) +4 for a scientific name
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Biodiversity Challenge

(continued)

	Name	What is it?	Points
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Biodiversity Blitz Resources

Scientific Naming

Use the prefixes and suffixes below to help come up with a scientific name for your new creature!

Prefis or Suffix	Meaning		Prefix or Suffix	Meaning
Acantha	Thorn		**Nektos**	Swimming
Actinos	Ray		**Nema**	Thread
Anellus	Little Ring		**Nidus**	Nest
Angio	Little Case		**Nuro**	Tail
Ankylo	Crooked		**Onycho**	Claw
Archae	Old		**Opsis**	Appearance
Arthron	Joint		**Orthos**	Straight
Bacillus	Little Stick		**Pachy**	Thick
Brachio	Arm		**Philos**	Loving *(example: water-loving)*
Bronto	Thunder		**Phyta**	Plant
Bryo	Moss		**Phykos**	Algae
Cephalo	Head		**Placo**	Flat
Cero	Wax		**Pod**	Foot
Ceros	Horn		**Pogon**	Beard
Chaite	Hair		**Porus**	Pore
Coel	Hollow		**Pseudo**	False
Compso	Pretty		**Psilo**	Bare or smooth
Crania	Brain		**Pteridion**	Wing or feather
Crustaceus	Having a shell or hard outer covering		**Rex**	King
Cryptos	Hidden		**Rhombus**	A spinning top
Cutis	Skin		**Rota**	Wheel
Dino	Terrible		**Rynchos**	Snout
Enteron	Intestine or gut		**Sapros**	Rotten
Firmus	Strong or durable		**Saur**	Lizard
Gnathos	Jaw		**Spira**	Coil or twist
Helmis	Worm		**Spora**	Seed or spore
Hemi	Half		**Stoma**	Mouth
Hyphos	Web		**Tener**	Soft
Micro	Small		**Thermo**	Hot
Morph	Form or shape		**Trophos**	Eater *(example: plant-eater)*
Myxa	Mucus		**Veloci**	Speedy
			Xenos	Stranger

(more on back)

Biodiversity Blitz Resources

Scientific Naming
(continued)

Prefis or Suffix	Meaning
Mono	One
Di	Two
Tri	Three
Quad	Four
Penta	Five
Hex	Six
Hept	Seven
Octo	Eight
Non	Nine
Deca	Ten
Centi	Hundred
Milli	Thousand

Biodiversity Blitz Resources

Dichotomous Key for Terrestrial Salamanders Found at Tremont

1A Rear legs larger and longer than front legs; light line from eye back to corner of mouth; often dark brownish overall, it is a **DUSKY SALAMANDER** (*Desmognathus* spp.), **GO TO 2.**

1B Legs all about the same size; line from eye to mouth absent; can be reddish, yellow, golden, gray, black, or a variety of other colors, **GO TO 3.**

2A Tail rounded in cross-section; back usually with reddish and yellowish stripe, edges either straight or wavy; belly usually gray speckled with white; may have orange or yellow cheek patches (make note if you find one with orange cheeks), it is an **IMITATOR SALAMANDER** (*Desmognathus imitator*)

2B Tail keeled in cross-section; back is mottled olive, sometimes with some chestnut; belly is light colored, usually with YELLOW UNDER THE TAIL; small white spots along side of body and usually along sides of head, it is a **SANTEETLAH SALAMANDER** (*Desmognathus santeetlah*)

3A Slender and short-legged; yellow, orange, or golden, it is a **BROOK SALAMANDER** (*Eurycea* spp.), **GO TO 4.**

3B Not especially slender and/or not yellow, orange, or golden, **GO TO 5.**

4A Two dark stripes down the side of back; belly unpigmented and is whitish, yellow, or reddish; tail long and thin; looks and often moves like a tiny yellow snake, it is a **BLUE RIDGE TWO-LINED SALAMANDER** (*Eurycea wilderae*)

4B Black spots on back, spots becoming bars on the sides of the tail; belly yellowish to cream color; tail very long, usually comprising over 60% of the total body length, it is a **LONG-TAILED SALAMANDER** (*Eurycea longicauda*)

5A Stout-bodied; red, orange, or pink with speckles, **GO TO 6.**

5B Slender-bodied; gray, black, or red only on back, **GO TO 7.**

6A Reddish with black speckles all over body, including belly; black chin; eye yellow or golden, NOT brown, it is a **BLACK-CHINNED RED SALAMANDER** (*Pseudotriton ruber schenki*)

6B Reddish, purple, or salmon color; black speckles over back, but not on belly; tailed keeled; dark lines from eye forward to nose, it is a **SPRING SALAMANDER** (*Gyrinophilus poryphyriticus*)

7A Black on back and belly with white speckles all over, especially on back and sides, it is a **NORTHERN SLIMY SALAMANDER** (*Plethodon glutinosus*)

7B Salamander not black with white speckles, **GO TO 8.**

8A Salt-and-pepper belly; back is either with a red or grayish straight-edged stripe; some times with a reddish tip at the nose; never has stripe on side of head like a dusky (avoid confusing this species with Imitator Salamander), it is a **SOUTHERN REDBACK SALAMANDER** (*Plethodon serratus*)

8B Belly is gray to black with no little to no speckles; back with reddish zig-zag stripe, which is often dark and hard to distinguish; may be reddish coloration where the limbs join the body; sides are dark with tiny white spots; tail may have pattern of medium-sized spots; (this species is easily confused with Southern Redback Salamander), it is a **SOUTHERN ZIGZAG SALAMANDER** (*Plethodon ventralis*)