Unit
Ecology

Title
7. Habitat Survey

Summary
In this activity, students finally get to apply their skills of soil analysis and observation to a 1 meter by 1 meter area of the schoolyard, restoration site, or creek bank. Teams of students get down and dirty exploring the soil, vegetation, and insect life in their microhabitat. Students practice using the soil analysis tools they learned previously and also practice using field guides to identify plants and insects. Upon returning to the classroom, they compare their results with other groups to see the differences and similarities between their microhabitats. This is a superb activity to use before and after a habitat restoration project or simply to track changes in a habitat throughout the year. I used this investigation to introduce the idea of native vs. non-native species and to begin a debate about invasive species. My students really "got it" when they examined our adopted restoration area and discovered that there was a monoculture of invasive, non-native English ivy all across our site. They visited our adopted site 3-4 times throughout the year pulling ivy and planting native plants. When all was said and done, they repeated this investigation in the spring to discover exactly the magnitude of the change they made on the environment – and to find that the native plants recruited a wider variety of insects than they had seen at that site in the fall.

Objectives
Can conduct tests of soil quality.
Can interpret tests of soil quality.
Can identify insect, animal and plant species in the field.
Can define habitat and microhabitat.
Can record and interpret data in a science lab notebook.
Can apply classroom knowledge to real world data.

Vocabulary
Microhabitat
Invasive species
Native species
Non-native species

Time
For habitat survey:
40-50 minutes at the creek
traveling time varies

For setting up the soil analysis tests in the classroom:

10-15 minutes to set up soil separation and Tullgren funnel tests
10 minutes to identify plants and insects

A day later, analyze the results and have a class discussion:
10 minutes to interpret soil separation and Tullgren funnel tests
10 minutes to compare results with another group
20-30 minutes group discussion

Grouping
2-4 students

Materials
For habitat survey, each group of students needs: (I assembled all the materials into several shoebox-sized plastic containers to become our class set of "creek kits")

- Copy of Habitat Survey Sheets (downloadable below)
- 1 petri dish
- 2-3 strips pH paper
- 10 ml of water (A film canister is a handy, free, container and measuring tool. To be more accurate with your measurements, you can buy plastic, graduated 15 ml test tubes)
- 2-3 white paper towels
- 1 ziplock bag
- 1 extra-large spoon or small hand trowel
- 1 hand lens or magnifying glass
- 4 meter length of string tied into a knot every 1 meter (brightly colored polyester contractor's string works well)
- 1 roll scotch tape
- optional: bamboo skewers or other sticks/stiff wire to stake out the string

For the habitat survey, the teacher needs:

- first aid kit
- gloves and a plastic bag (for unsavory trash items)
- extra copies of the Habitat Survey Sheets
- field guides of local plants and insects
- optional: water and paper cups

For classroom tests and interpretation each group needs:

- 1 petri dish
- 1 funnel (card stock paper rolled and taped into a funnel shape and cut to 4-6 inches tall may be substituted)
- 1 funnel holder to hold funnels upright above a Petri dish (card stock paper rolled into a tube works well or you can eliminate the Petri dish as well by using a cup that the body of the funnel rests in as long as the bottom tip of the funnel does not touch the bottom of the cup)

- 1 square of cheesecloth
- 1 clear 15 ml tubes with lids, glass or plastic

For classroom tests and interpretation the whole class can share:
- printout of the instructions (downloadable below).
- 2 tablespoons
- 2 rulers
- 3-4 bare light bulbs hung or mounted approximately 1 foot from the table top (desk lamps work well)
- 1 small jar alum (available at supermarkets for pickling)
- 1 package removable dot labels or rolls of masking tape
- assorted field guides of plants and insects

Setting
Habitat surveys can occur in any large outdoor area such as the schoolyard, a habitat restoration site, a garden, or the bank of a nearby creek. The following instructions were written for my students who did this activity along the bank of a creek. If you are heading away from school, make sure that you have permission to conduct your experiments from the proper authorities/property owners/neighbors.

The second half of this activity occurs in the classroom.

Teacher Background
Most of us are familiar with the threats to ecosystems such as rainforests, wetlands, and oceans. Naturally, anything that is a concern on a large scale such as global warming or clear cutting should be studied and researched. However, many organisms do not use an entire ecosystem. Most live in a relatively tiny portion of a larger ecosystem, a microhabitat. In fact many organisms spend their entire lives within a 1 meter square area. It is essential to recognize that organisms do not need an entire ecosystem to be damaged to find that their little microhabitat has been destroyed.

I believe that science skills such as water quality monitoring or soil analysis are of little interest to students unless these skills are applied in the real world to real problems that may not have ready-made solutions. Therefore, after teaching them how to make observations and analyze soil samples in the classroom, I take my students to apply these skills to a real world problem – invasive English ivy that has taken over the bank of a nearby creek. This problem gives students an opportunity to carefully monitor a microhabitat, recognize that ecology happens on a small scale (as well as a larger scale) that an individual person can make a difference on, and create a plan of action to help their microhabitat.

Invasive species are organisms that not only are non-native, but which take over a habitat and out-compete the native organisms. There are many examples of invasive species. Each has a story about where the invasive species came from, how it got to

the area, and what adaptations allow this species to out-compete the native species that typically occupy that niche of the food web. English ivy is just one example. It was brought over to America by Europeans who decorated their houses and gardens with this robust, fast-growing vine. In Europe, ivy does not out-compete the plants in the local ecosystems, however, in California, ivy will quickly invade and cover large areas to the exclusion of all other plants.

For middle school students, it is important to draw the distinction between non-native species and invasive species. Not all non-natives are "bad". One can think of it like diversity in a community of people. Newcomers to a community are welcome and bring new points of view and new ways of doing things. However, if a small group of newcomers start killing off all of the "natives" by crowding them out and taking all the resources then those newcomers are no longer welcome.

This activity plays a role in that the microhabitat survey allows students to observe that there is an extreme difference between those students who have a microhabitat in the ivy covered area and those who have a microhabitat elsewhere along the creek bank. They observe first hand how ivy is invasive and can come to the definition of a native species, non-native species, and invasive species through their own observations. We then decide upon an action plan to restore the ivy area to a more native state and begin our restoration activities. At the end of the year we repeated the microhabitat survey to see how well we did with our goals.

Depending on the message you wish to convey with your own students, the focus of this investigation will vary. I chose to assign half the students sites in the ivy area that we plan to restore and the other half sites in a previously restored area. Other ideas include investigating shaded versus sunny microhabitats, schoolyard versus garden habitats, organic versus fertilized garden habitats, and virtually any other comparison you can imagine.

Student Prerequisites

Soil analysis skills (see Soil Analysis Lesson).
Basic understanding of habitats and ecosystems (see Terraqua Columns, Food Chains, Food Webs, and Ecosystem Organization Lessons).
Ability to use a field guide (see Food Webs Lesson.

Getting Ready

For habitat survey:

1. Contact the proper authorities/property owners/neighbors to obtain permission to bring your students to your chosen survey site.
2. Copy Habitat Survey Sheets. Make extra copies of the last 2 pages for the vegetation and insect surveys to bring with you in case students find more examples of plants or insects than their sheet allows them to fill in.

3. Prepare "creek kits" with: petri dish, pH paper, water, paper towels, ziplock bag, spoon or small hand trowel, hand lens or magnifying glass, 4 meter length of string tied into a knot every 1 meter, scotch tape, and stakes.
4. Prepare teacher bag.
5. Arrange transportation to and from the survey site.

For classroom analysis:

1. Prepare 2 stations around the classroom with the materials needed to conduct that test and a printout of the instructions.
    a. Soil separation: 15 ml tubes, alum, ruler, labels, 2 different soils labeled in plastic cups, spoons
    b. Tullgren Funnel: lightbulbs, funnels, cheesecloth squares, funnel holder, petridishes or cups, labels, 2 different soils labeled in plastic cups, spoons
2. Set up an example of a Soil separation test and a Tullgren funnel test at each of those stations.

Lesson Plan

For habitat survey:

1. Explain the purpose of today's investigation to the students before you leave the classroom. If there is a specific question you are investigating, clearly state your question now. The question for my students was "How diverse is the existing ecosystem along the creek bank?" Set out the rules and expectations. You may want to hand out the Habitat Survey Sheets now. I had my students staple each page into their lab notebooks the night before as homework so that each student had a chance to look at the types of data they would be collecting and had a hard surface in which to take notes outdoors.
2. Tell students what teams they will be working with and how to find a survey site (you can assign them there or they may find their own site). Show them how to stake out their survey site with the string and stakes.
3. Depart for the trip.
4. When you arrive, make sure that each team has an appropriate survey site and a creek kit. Make sure that groups are setting up their string and stakes correctly.
5. Allow students to get started immediately collecting the information on their sheets. Circulate among groups to help students who have questions.
6. Teams that finish early can sit quietly with a field guide and try to identify the plants and animals they found.
7. When all groups are finished, return to the classroom.

For setting up soil analysis experiments in the classroom:

1. Tell students to get out their soil samples and Habitat Survey Sheets from their survey site. Tell them that their objective in the next 20-30 minutes is a) to set up a Tullgren funnel with their soil, b) to set up a soil separation test with their soil, and c) to identify the plants and insects at their site using the field guides. Show the students where in the classroom each of these activities can be done.

Specify a rotation schedule or divide up the groups to split the work between the team members.
2. Allow students to accomplish each of these tasks, allowing enough time for clean up at each station before rotating to the next area.

For final analysis of results in the classroom:

1. Give students an overview of today's class and your goals. Remind them of the purpose of this activity and the question you posed at the beginning of this activity. Write this question or your purpose on the board.
2. Allow students 10 minutes to interpret soil separation and Tullgren funnel tests and clean up those stations.
3. When all students are back in their seats, pair each team of students up with another team and ask them to compare their results. Tell them that they will report back to the whole class about a) similarities between their survey sites, b) differences between their survey sites, and c) anything that surprised them during this investigation. On the board, below where you wrote down the question or purpose, create a table with the following columns: Similarities, Differences, Surprises. Give the students 10 minutes to discuss their results with another team.
4. Allow each pair of teams to share their findings with the class. Write up their discoveries on the board.
5. Once all pairs of teams have shared, begin a class discussion. Some discussion questions you may want to consider include:
    - What similarities did groups find? Why might those similarities exist?
    - What differences did groups find? Why might those differences exist?
    - Why did you find certain things surprising? What did you expect at the beginning?
    - These small habitats are considered microhabitats. What factors in the environment might create microhabitats? (examples include a road or path that divides one area from another, areas of shade or sunlight, proximity to a water source, etc.)
    - What creatures might live their whole life in only one microhabitat? What creatures wander from one microhabitat to another?
    - Were we able to answer the question with the data we collected?
    - Are there additional observations we could have or should have made to better answer the question?
    - Is the area we studied a healthy habitat? Why or why not?
    - Is the area we studied a sustainable habitat? Why or why not?
    - What could or should be done to improve this area? Could we as a class do anything to improve it?

Assessment

1. Ask one or more of the discussion questions as a homework/assessment question. In particular, the question "Is the area we studied a healthy habitat?

Why or why not?" and "What could or should be done to improve this area?" are excellent questions for students to think more deeply about.

Going Further

1. Conduct a restoration project at the survey site! Turn the student's good ideas into an action plan to improve the habitat.
2. Have students research and design a balanced, diverse and sustainable ecosystem for the are they studied. See Ecosystem Plan Project for concrete ideas of how to structure this research project.

Sources

The idea for this activity came from several other lesson plans designed for transect survey sites. I was inspired by the following lessons:

- "On-Site Lesson Plan" in Monitoring Creek Health (http://www.nps.gov/pore/curriculum_guides/creek_health/index.html)
- "Activity 7: Microhabitats" in the book Environmental Science Activities Kit : Ready-To-Use Lessons, Labs, and Worksheets for Grades 7-12 by Michael Roa
- "Weeding Out – River Plant Survey", "A Matter of Trash – Pollution Survey" and "Macroinvertebrate Investigation" from Friends of the LA River's science curriculum (http://www.folar.org/)

See the Soil Activity for source information about the soil analysis tests.

You can obtain 15 ml graduated test tubes from BD sciences (http://www.bdbiosciences.com/discovery_labware/Products/tubes/conical_centrifuge/). You can order a bag of 50 of them at Superior Scientific for $6 (http://lab-suppliesonline.com/product_info.php/products_id/1513)

Standards

Grade 6

Ecology (Life Sciences)

5. Organisms in ecosystems exchange energy and nutrients among themselves and with the environment. As a basis for understanding this concept:

a. *Students know* energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis and then from organism to organism through food webs.

b. *Students know* matter is transferred over time from one organism to others in the food web and between organisms and the physical environment.

c. *Students know* populations of organisms can be categorized by the functions they serve in an ecosystem.

e. *Students know* the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.

Grade 8

Reactions
5. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:
e. *Students know* how to determine whether a solution is acidic, basic, or neutral.

All grades

Investigation and Experimentation

7. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.