

Microhabitats #1: Quantitative Study of Microhabitats

Adapted from: "Microhabitats" in Environmental Science Activities Kit by Michael Roa. The Center for Applied Research in Education, 1993.

Grade Level: all

Duration: 2 class periods

Setting: pond or stream field site

Summary: Students examine and compare microhabitats in an aquatic ecosystem, devising a sampling method and recording physical and biological data.

Objectives: Students will recognize that habitats are composed of many different microhabitats, each with distinct organisms in them.

Related Module Resources:

- Various Macroinvertebrate Activities, Fact Sheets [binder]
- Books/Field Sheets
- Videos: Creatures of the Pond, SOS for Americas Streams
- Reference Collection:bugs

Vocabulary: habitat, microhabitat, clingers, sprawlers, climbers, burrowers, floaters, qualitative and quantitative study

Materials (Included in Module):

- D-frame nets
- Kick nets
- White Plastic Sheets
- Sorting Equipment: Forceps, spoons, & eyedroppers, Magnifying glasses /boxes
- White sorting trays
- Bug ID cups
- Macroinvertebrate guides, field sheets, books [folder and box]
- Brock Microscope

Additional Materials (NOT Included in Module):

- Thermometers (optional)
- Water chemistry kits (optional)
- Boots, creek sneakers, or waders

ACADEMIC STANDARDS (ENVIRONMENT AND ECOLOGY)

7th Grade

- 4.1.7.C Explain the effects of water on the life of organisms in a watershed.
- Explain how the physical components of aquatic systems influence the organisms that live there in terms of size, shape and physical adaptations
- 4.6.7.A Explain the flows of energy and matter from organism to organism within an ecosystem.
- Describe and explain the adaptations of plants and animals to their environment
- 4.7.7.C Explain natural or human actions in relation to the loss of species.
- Explain why one species may be more susceptible to becoming endangered than another species

10th Grade

- 4.1.10.C Describe the physical characteristics of a stream and determine the types of organisms found in aquatic environments
- Describe and explain the physical factors that affect a stream and the organisms living there
 - Categorize aquatic organisms found in a watershed continuum from headwaters to mouth (e.g. shredder, predator, decomposer).
 - Identify the types of organisms that would live in a stream based on the streams physical characteristics.
 - Explain the habitat needs of specific aquatic organisms
- 4.6.10.A Explain the biotic and abiotic components of an ecosystem and their interaction.
- 4.7.10.B Explain how structure, function and behavior of plants and animals affect their ability to survive.
- Describe an organism's adaptations for survival in its habitat
 - Compare adaptations among species
- 4.7.10.C Identify and explain why adaptations can lead to specialization.

12th Grade

- 4.6.12.A Analyze the interdependence of an ecosystem.
- Analyze the relationships among components of an ecosystem

BACKGROUND:

Although ecosystems can be very large, such as rainforests, oceans, and rivers, most organisms do not utilize an entire ecosystem as their **habitat**. A habitat is a place that an organism lives in, which fulfills its need for food, water, temperature, reproduction, and space. Instead, they utilize only a relatively small portion of a large habitat. This is their **microhabitat**.

For example, aquatic insects live in microhabitats that are subdivisions of the larger aquatic system. **Clingers**, like the water penny and the net-spinning caddis fly, are a group of insects that live only on the substrate surface in fast flowing water. The stonefly is a **sprawler** whose microhabitat is composed of rocky or stony substrate filled with leaf and other organic debris. The **climbers** occupy a different microhabitat;

they reside primarily on the stems and roots of plants in the slow moving waters at the edge of streams, ponds, and lakes. **Burrowers**, such as the burrowing mayfly, have a microhabitat within silty substrates. **Floaters**, such as the mosquito larvae, live just below the water surface. Insects are not the only organisms in a stream that reside in specific microhabitats; fish, amphibians, and some animals also have microhabitats in our waterways.

It is important to identify and understand microhabitats because destruction of an individual microhabitat can result in the death of an entire species while not showing major changes to the larger habitat. The destruction of certain microhabitats can be a serious threat to the entire ecosystem. For example, excessive siltation may damage the stony microhabitat of the sprawlers. Loss of the sprawlers could have a major impact on the entire ecosystem, yet, the overall habitat would not appear to have been greatly changed. Thus, it is necessary to study not only large ecosystems, but also microhabitats and the specific needs of specific organisms and their relationships with other organisms.

Microhabitats can be studied **quantitatively** or **qualitatively**. A quantitative study requires that data are measure, not simply observed. The amount, number, size, shape, and degree of all factors must be measured and recorded. For example, a quantitative study of an aquatic microhabitat would require recording the amount and type of aquatic life present and could include the study of other water parameters (temperature, water flow rate, etc.). Quantitative studies are also much more concerned about specific scientific procedures in collecting data, procedures that could possibly be repeated in the future to compare data.

A qualitative study is less strict, less scientific in the approach, and is more concerned with visual observations and discovering all of the organisms within the microhabitat. It does not require that measurements and records are made of how many or how much of something is present. The qualitative study simply asks what was observed. And it doesn't really matter how the observations are made; procedures can vary and be less technical because they do not have to be specifically repeated in the future.

OVERVIEW: Students examine and compare microhabitats in an aquatic ecosystem, recording physical and biological data. Students will collect aquatic organisms in a quantitative study.

PROCEDURE:

Teacher Preparation:

Before visiting the site with your students, check it out to be sure that it is safe and wadeable and that there are plenty of different microhabitats. The area selected should be safely and easily accessed. If on private property, permission must be obtained prior to the field trip. All those going on the field trip should be dressed appropriately – with old clothes that can get wet. Make sure everyone is wearing either boots, waders, or old shoes – no one should go barefoot into a waterway.**

Student Activity:

1. Discuss the background information on habitats. Try to emphasize the idea that a given habitat might have a variety of habitats within itself. Introduce the term “microhabitat.”
2. Instruct the students on the use of all equipment they will be using. Make sure you have instruction sheets for how to use kick nets and d-frame nets. To sample macroinvertebrates, use appropriate nets. For rocky stream bottom sampling, a kick net is best. D-nets are probably best for most other microhabitats. Don’t forget to tell them how to use the field guides!
3. Divide students into teams of two to four. Tell students that they will collect aquatic organisms from a specific microhabitat to which they will be assigned (a list of microhabitats is on the side). The students will be conducting a quantitative study of the organisms – review this concept with them.
4. Based on the microhabitat they have been assigned, students will need to devise a quantitative procedure for how they will collect their aquatic organisms. It must be a procedure that could be repeated by another group in the future so that the data collected could be compared. An example of a procedure might be – we will kicknet one square meter in our riffle microhabitat for three minutes. That could be repeated. We are going to just kick around in the riffle is not specific enough and could not be repeated. Have them record their procedure on their data sheet – you decide how detailed it should be.
5. Be sure to approach the microhabitat carefully so organisms are not scared away. Collect data on temperature and any other water chemistry parameters you want. Describe the microhabitat in detail. Record the data on the Data Sheet.
6. Sample the organisms in the microhabitat using the procedure that the students decided. A quantitative study is very interested in the exact type and number of organisms found, so have them identify and record the number of the organisms found in their microhabitat. If fish or other vertebrates are visible, identify them to the best of your ability (if unable to give them a name, describe their size and shape and anything else you can observe). Descriptions of the aquatic macroinvertebrates could also be recorded. Record data on the data sheet.
7. Compile the class data on the chalkboard. Each group may want to give a short presentation on what they found in their microhabitat.

Waterway Microhabitats

Examples

Riffle (shallow, fast water)
Pool (slow, deep water)
Run (deeper, moving stretches)
Side channel
Puddle
On a sandbar/gravel bed
Next to shore
On the water surface
Within the water column
Under / on large rocks
Under small rocks/gravel
Under/on logs
Within tree roots in water
In muddy bottom
In beds of vegetation
On floating plants

DISCUSSION:

Discuss the results with the students. Which organisms were found in only one microhabitat? Why might this be so? Which were found in almost all microhabitats? Why? *Certain organisms are better adapted to life in particular microhabitats than others are. The more tolerant macros will be found with in more varied microhabitats.*

Which microhabitat had the largest variety of aquatic insects found? *Probably riffle.*

Are aquatic creatures the only organisms that have microhabitats? *No, almost all creatures, aquatic and terrestrial have microhabitats.*

If an organism has a very specific microhabitat, does the whole ecosystem have to be destroyed for that organism to be affected? *No, only their microhabitat needs to be destroyed for them to be affected.* If one microhabitat is affected by some sort of change, is it likely that other microhabitats within that ecosystem will also be affected? Could the whole ecosystem eventually be destroyed?

Which types of organisms are more likely to become endangered by rapid environmental changes, such as those caused by humans – organisms with specific habitat requirements or more general habitat requirements? Why? *Generally, organisms that have evolved very specific requirements for survival – such as specific microhabitats – have trouble surviving if their environments change rapidly.*

Why would it be an advantage for an organism living in a relatively stable environment to have specific habitat or food requirements? *If an organism lives in a stable environment, it may be advantageous to specialize to take advantage of specific conditions more efficiently than other organisms that do not specialize.*

What is the difference between a quantitative and qualitative study? *See background section.* Could a class 2 years from now exactly repeat the procedures that you conducted to find organisms?

EVALUATION:

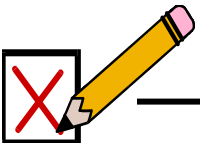
- Describe the physical characteristics and organisms in a specific microhabitat.
- Explain why certain organisms live in their specific microhabitats.
- Explain why it is important to protect microhabitats as well as entire ecosystems.
- Discussion questions above
- Correctly filled out data sheet

EXTENSIONS AND MODIFICATIONS:

- Use the Aquatic Insect Research Planning Sheet at the end of the activity to make students make predictions on what kind of bugs they will find in microhabitats or prediction on where they might find the best biodiversity, etc.
- Research the organisms found in the microhabitats.
- Do a population density study for various organisms. Graph the data.

NOTES (TEACHERS, PLEASE WRITE ANY SUGGESTIONS YOU HAVE FOR TEACHERS USING THIS ACTIVITY IN THE FUTURE):

Activity Version: January 2002



DATA SHEET : MICROHABITATS #1 – QUANTITATIVE STUDY

Student Name _____ Date _____

Other Students in Group _____

Microhabitat Assigned _____

Procedure that will be used to sample aquatic organisms in this microhabitat:

Microhabitat Description _____

Time of data collection _____ Water temperature (if done) _____

Weather conditions: current _____

recent past (last several days): _____

Light conditions (sunny/shady) _____ Speed of water (circle one): fast medium slow

Color and cloudiness of water _____

Other Notes or Tests Conducted:

Organism data table on back



PLANNING SHEET: **Aquatic Insect Research Planning**

Group Names: _____

Area of Study:

Hypothesis:

Plan of Study:

