Water Quality

Assessing water quality in the streams of Black Rock Forest

INTRODUCTION

Observations of our environment tell us that water and life are associated with one another. Without water, many organisms, including human beings, would cease to exist. The earth's water can be divided into two categories: fresh water and salt water.

Limnology is the study of fresh water bodies, such as ponds, lakes, streams and their inhabitants. Fresh water is deposited on land in the form of precipitation, rain and snow. Mountains shed their excess water from rain and snow. This excess water meanders its way via streams to lower levels in the forest where it forms bodies of water such as ponds and lakes. Over abundance of fresh water ultimately empties into the rivers.

In Black Rock Forest, our focus is specifically stream water and its quality. We are fortunate that there are many peaks and mountains in Black Rock Forest with numerous streams carrying water to lower lying levels in and around the forest.

One way of monitoring water quality in fresh water streams is using an invertebrate count. Insects and small invertebrates can be found in greater or lesser quantities in streams. These organisms require specific conditions in order to maintain life.

Environmental changes such as the pH and the temperature of stream water can affect the ability of organisms to survive and reproduce. By measuring stream conditions we can determine their overall quality and determine their ability to support diverse life forms. The presence and/or absence of different species of insects, crustacea and mollusks indicate the quality of each stream's water.

OBJECTIVE: ***To demonstrate that the quality of stream water is affected by its environment.***

- Collect samples of invertebrates in one of the streams
- Identify 'the catch' using the key provided
- Understand how the water's quality affects organisms found living there
- Appreciate that the condition of the water dictates the presence and/or abundance of organisms there
- Understand that the absence of organisms also dictates the condition of the stream's water
- Analyze the conditions surrounding the stream
- Evaluate the possible interactions of living things in the environment.

- Gain an understanding of the delicate balance of nature
- Appreciate that natural environments can teach us about the world in which we live.
- Foster team work

VOCABULARY

agitate	angle	crustacean	downstream
insect	invertebrate	limnology	mollusk
pH quality	riffle	ripple	seine
scrubber	stream bed	tweezers	upstream

MATERIALS

For each participant:

- hand lens
- clip board
- pencil
- tweezers
- change of clothing
- pair of old sneakers
- rubber gloves (optional)
- For each team (one instructor and about six students)
- 1 seine net
- 3 white buckets
- 1 watch
- 1 yardstick
- 1 thermometer
- 1 pH test kit
- dissolved oxygen kit (teams can share this)
- 50 inch tape measure
- 1 white collection pan
- clear water collection jars
- magnifying glass
- 1 utility table, foldaway or similar type
- Black Rock Forest Stream Quality Survey
- Stream Insect & Crustacean Identification Key

METHODS

A. Locating a Stream

1. An ideal stream that can be used to perform an invertebrate count is one that is fast moving with maximum depth of about two feet.
2. The bottom of the stream must be rocky; these rocks provide attachment surfaces for the insect larvae and small invertebrates.

B. Testing the water's pH

1. Take a clear water collecting jar
2. Fill it with water from the stream, before the water is disturbed.
3. Dip a pH strip in it –following directions on the box of strips
4. Read and determine the pH of the water by matching the color of the dipped strip with the chart on the pH strips container (box)
5. Record the pH reading on the water/organisms analysis chart
6. Put the lid securely on the jar of water and examine it for solid particles floating around or settled on the bottom. Record findings.
7. Preserve this water for use later on, you may want to retest the sample (for pH, particles, or dissolved oxygen).

C. Seine Net Position

1. Establish upstream and downstream directions of the stream.
2. Identify stream by name.
3. Identify source of the stream and the name of mountain from which the water originates.
4. Identify streambed and its composition (rocky, muddy, etc.)
5. Measure the depth and width of the area being studied. Record findings.
6. Observe and record the density and variety of plants, trees included, and the amount of shade and/or direct sunlight the stream receives in this location.
7. Explain purpose of seine nets and importance of appropriate placement in the stream –prevents organisms from traveling with the water beyond the net and prevents injury to them
8. Demonstrate placement of seine net –arm extensions secured into stream bed until net brushes the water's bottom, the stream bed
9. Demonstrate angle of net –about 30 degree tilt –top (end without extending arms) leaning in the direction in which the water is flowing.

D. Agitators/rock scrubbers

1. Demonstrate positions for stream agitators and rock scrubbers –they should be
2. 6 to 9 feet upstream from the seine net
3. Demonstrate activities for stream agitators and rock scrubbers – they should disturb stream bed with hands and feet using sideways motions so that ground dwellers are dislodged and move with the water to the net where they become trapped. This activity should continue for about five minutes.

4. Scrubbing/brushing dislodges organisms attached to rocks and is accomplished with sweeping motions of the hands over rocks in the streambed.

E. Recovery Process:

1. Seine netters should wait a few minutes after agitators and scrubbers have completed their tasks.
2. Then, remove the net with a swooping, scooping motion in such a way as to preserve the captured organisms
3. Carefully, carry the net to the stream bank
4. Place the net on the raised flat surface, i.e., a table.
5. Using tweezers all team members should participate in carefully lifting all (even worms), captured organisms from the net and place them in the collection trays (light colored or white plastic soup/cereal bowls are ideal) according to observable categories. Make sure there is some water in the bowls/trays. Use the bug boxes for bugs that are likely to escape if not enclosed.
6. Using the Insect & Crustacean Identification Key identify the organisms. Use primary body shape and number of legs to aid in identification as members of the same family may vary in size and color. Sort the look-alike groups into white buckets and collection jars.
7. The process observer should tabulate the findings in Part 2 of the water quality data sheet and summarize the data.
8. All teams use their data gathered in Part 2 to determine the quality of the water tested.
9. Regroup group and allow teams to share information gathered by each. If there is discrepancy within the group, combine and analyze the collection of each team's findings for the entire group (class). This may be advantageous in determining the water's overall quality; if the same stream was used by all the teams and results (for example, the water's pH) were not the same for all teams. (As a general rule, all teams' findings concur.)

DRAWING CONCLUSIONS

Ask questions to provoke discussion. Examples:

1. What environmental conditions might have brought about the water quality rating of this stream?
2. Do you think the invertebrate count varies with different environmental conditions, such as changes in water temperature, pH, weather conditions, climate and location?
3. Have we gathered any evidence that would lead us to predict that environmental conditions determine what organisms survive within given conditions? Explain.
4. Compare your team's findings with teams that analyzed a different stream – are there similarities? What are the differences? Explain.
5. How do you think results from an urban stream might differ with the results attained at this site? Explain your answer.
6. If you repeated this activity in the same stream one year from now do you think the results would be the same? Explain your answer.

7. Do you think this activity would produce different results if the experiment were conducted in different seasons of the year? Explain your answer.

NOTES TO THE GROUP LEADER (TEACHER)

1. The actual fieldwork will take about three hours.
2. Since the group will be working in teams (consisting of about six students and a team leader) you may want to arrange your teams first and have members choose from the variety of tasks that will be performed by each group.
3. Team Tasks

   one pH (water quality) testosterone process observer, two seine netters some agitators and rock scrubbers.

   This is an activity that students, young and old, love. (Even the reluctant ones in the group end up having a great time especially if they see you are having a good time and are not put off with the idea of touching bugs and getting into it.) They have a chance to get down and dirty and thoroughly wet. Regular forest clothing and old sneakers that won't break hearts when they get wet. Footwear is required as rocks are sharp, jagged and heavy and impose injury without warning on unsuspecting feet; sandals offer little or no protection.
4. Practice in classifying objects using any appropriate identification key is desirable.
5. Pre-Viewing the "Save Our Streams Training Video" would be helpful as would reading pamphlets such as "Stream Quality Assessment." (Both are available from the Izaac Walton League.)
6. You may want to review collecting and sampling techniques.
7. Remember to demonstrate the wafting method of smelling the water rather than putting the substance to be smelled right under the nose. Waft method: hold the substance about six inches from the nose and, with gentle hand motions, wave the odor toward the nose.
8. You may also want to review the water quality data sheet and the identification key with the students before the activity.
9. A basic understanding of acids, bases and neutral substances would greatly enhance the students' understanding of pH. For example: milk is a base (it is sweet tasting), vinegar is an acid (it tastes sour), bottled distilled water is not sweet or sour; it is neutral. The acids and bases in it are perfectly balanced and cancel each other. Other substances could also be used to demonstrate these principle
10. Extensions of this field experience (using the same methodology), when students are back in their school environments, might include:

    *Comparative study sampling streams in different, i.e., suburban, urban, rural communities.

    *A yearlong water monitoring project of a selected stream, noting any significant changes in water and organisms.

    *Comparing stream quality ratings and their related life forms in different biomes such as deserts, grasslands, woodlands (with pen pals/study pals via the Internet).

    *Continuation of study of same stream from year to year for water quality rating over an extended time period. It is suggested that students engage in background

reading on concepts in limnology, streams and stream life, and introduced to the appropriate vocabulary.

11. As you discuss appropriate clothing to wear, it is a good idea to wear the outfit yourself, demonstrating as you go. Dressing comfortably and appropriately is very important. Long pants tucked into white socks prevents any undesirable bugs, i.e. ticks, from landing on the flesh attaching themselves and helping themselves to free meals and possibly inflicting diseases, an example being lime disease. Long sleeved shirts (but short sleeved acceptable), definitely all tucked into pants (no midriffs showing), are strongly suggested for the above noted reasons. Tick checks are suggested for all hikers at the end of the day. This just means that skin should be checked for bumps and rashes not normal to the individual. A small demonstration of the process and partners can check the body parts of each other that they cannot see for themselves.
12. If the forest is an unfamiliar place for the students or group it is important to foster a sense of calm as well as adventure as the forest can be frightening experience for a first time visitor.

RESOURCES

Izaac Walton League "Save Our Stream" materials available through:
The Izaac Walton League, 1401 Wilson Blvd., Level B, Arlington, VA, 22209.
Telephone: (703) 528-1818

Water Quality Monitoring – A Guide for Concerned Citizens, Barbara Dexter and Richard Harris, The Long Island Task Force, 1922.

Essman, J. and Zarpas, S. Canaries of the Stream. The Conservationist. 1990; 44 (6): 8-15.

We suggest the use of the LaMotte wide range pH test kit (model P-3100) for Part I of the water quality survey. Although other more general tests can be used in pH measurement, this kit allows accurate determination of water pH. This kit can be purchased through the: LaMotte Company, PO Box 329, Chestertown, MD, 21620. Telephone: (800) 344-3100