Name ______________________________ Class ______________ Date ____________

Exploration Lab **FIELD ACTIVITY**

# Inferring Water Quality

A healthy stream that is free of pollutants and human disturbance provides a good habitat for a variety of invertebrate populations, the most common of which are insect larvae and nymphs. Various aquatic worms and small crustaceans, such as sow bugs, scuds, and crayfish, also are abundant in fresh water.

The health of a stream can be determined by testing its pH and its levels of dissolved oxygen and nitrogen compounds. However, these chemical tests require costly test kits and equipment. A less expensive method for gauging water quality is sampling the living water-quality indicators—populations of aquatic invertebrates that normally live there. Scientists divide these indicators into three major groups according to their sensitivity to pollution. You can see some of these organisms in Figure 1. If certain species are missing, there is a good chance that the stream has suffered some form of pollution. In this activity, you will monitor a local stream for living water-quality indicators.

## FIGURE 1: LIVING WATER QUALITY INDICATORS

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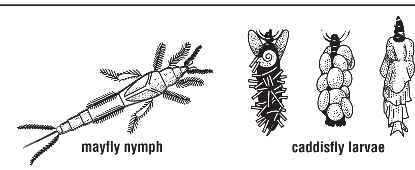
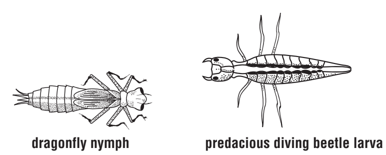
|---|---|
| **Most-sensitive species**<br>Caddisfly larvae, hellgrammites, stonefly larvae, mayfly nymphs, gilled snails, and water penny larvae |  |
| **Moderately sensitive species**<br>Clams, cranefly larvae, crayfish, damselfly nymphs, dragonfly nymphs, scuds, predacious diving beetle larvae, sowbugs, fishfly larvae, and alderfly larvae |  |
| **Tolerant species**<br>Aquatic worms, blackfly larvae, leeches, midge larvae, and pouch snails |  |

## OBJECTIVES

**Identify** living water-quality indicators in samples of water.

**Calculate** Total Stream Quality.

**Infer** stream quality from collected data.

**Evaluate** methods of determining water quality.

## MATERIALS

- hand lens
- macro-invertebrate identification key or pond life field guides
- net, fine mesh plankton, or dip nets
- plastic-foam egg cartons

## Procedure

1. Research some of the living water-quality organisms. What specific characteristics do these organisms have to make them indicators of good water?

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2. If the measured pH and dissolved-oxygen levels for a stream were in the normal range, which groups of macro-invertebrates would probably be present?

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3. Select a portion of a rapidly moving body of water to conduct your study. For best results, find a place where the water is flowing over a rocky bottom. If the stream bottom in your area is not rocky, try to find sections of the stream that are clear and flowing.
4. Overturn some rocks upstream from where you intend to sample to dislodge those species using rocks as a refuge. Stir the bottom of the sample area with a stick or your feet to dislodge bottom dwellers. The water may be very cloudy at this point.
5. After the water runs clear, draw the plankton net through the water by the end of the cord. Tiny floating organisms will be funneled through the net into the attached bottle. Take the plankton net to shore, and separate species by placing each species into an egg carton compartment filled with water. Be careful not to drop any of the organisms.
6. Use the identification key or field guides to identify and count the number of each species collected. Record the count for each species in Table 1. Return the collected specimens to the stream.

## Analysis

1. **Organizing Data** The letters A, B, or C are used in Table 1 to represent the numbers of organisms of each species collected in the field activity. A = 1 to 9, B = 10 to 99, C = 100 or more. Record the appropriate letter designation beside the name of each species in the table to indicate the relative abundance. Place a null sign, Ø, in the space next to the species name if no species were found.
2. **Organizing Data** Count the combined total of letters noted in the Most Sensitive Species column. (Do not count the null signs.) This sum is the Total Species Present (TSP). Record the total in the space for the TSP. Repeat this process for the Moderately Sensitive Species and the Tolerant Species.

## TABLE 1: STREAM SURVEY DATA

| **Most Sensitive Species** | | | **Moderately Sensitive Species** | | | **Tolerant Species** | | |
|---|---|---|---|---|---|---|---|---|
| Name | Amount | Letter | Name | Amount | Letter | Name | Amount | Letter |
| caddisfly larvae | | | atherix | | | aquatic worms | | |
| gilled snails | | | alderfly larvae | | | blackfly larvae | | |
| hellgrammite | | | beetle larvae | | | leeches | | |
| mayfly nymphs | | | clams | | | midge larvae | | |
| rifle beetles | | | cranefly larvae | | | pouch snails | | |
| stonefly nymphs | | | crayfish | | | | | |
| water penny larvae | | | damselfly nymphs | | | | | |
| | | | dragonfly nymphs | | | | | |
| | | | scuds | | | | | |
| | | | sowbugs | | | | | |
| | | | fishfly larvae | | | | | |
| Total Species Present (TSP) | | | Total Species Present (TSP) | | | Total Species Present (TSP) | | |
| Index Factor | TSPX3 | | | TSPX2 | | | TSPX1 | |
| Index Value | + | | | + | | | | |
| Total value | | | | | | = | | |
| | Stream Quality | | Poor (TV below 11) | Fair (TV 11-16) | | Good (TV 17-22) | Excellent (TV over 22) | |

**3. Examining the Data** Multiply the TSP for each column by the specified Index Factor (IF) to get the Index Value for each species. Notice that the Most Sensitive column has an IF of 3, the Moderately Sensitive column has an IF of 2, and the Tolerant column has an IF of 1. Add the three Index Values together to get the Total Value. Stream quality is determined by the Total Value. According to your calculations, is your stream quality poor, fair, good, or excellent?

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**4. Analyzing Data** The presence of a few organisms from the most sensitive or moderately sensitive category indicates higher water quality. Why do you think that the stream quality formulation is not based on the actual population number of each species present?

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5. **Identifying and Recognizing Patterns** Why is the Index Value higher for the more sensitive species regardless of the count for each species?

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## Conclusions

6. **Evaluating Results** Compare your data with data from another test site on the same stream. If the Total Value numbers of the sites differ, which species groups created the variation?

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7. **Evaluating Methods** Explain how collecting data for more than one site and averaging the resulting Total Values is a more valid measurement of stream quality than individual Total Values. What kind of information would be missed by averaging the data?

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## Extension

1. **Designing Experiments** Observe and keep representative organisms from each of the sensitivity columns in small aquariums for classroom observation. Note the habitat preferences and behavior of each. Compare their movement, anatomy, and coloration.
2. **Designing Experiments** How do you think samplings taken from a muddy bottom stream with marginal flow would compare to the results of this lab? Design an experiment to find out. With teacher permission, conduct your experiment and report your results to the class.