Pomme de Terre River Association
www.pdtriver.org

Macro-Invertebrate Game

Overview:

Macro-invertebrates are animals that do not have or possess backbones and can be seen without using a microscope. Many scientists and watershed specialists use these invertebrates to obtain a quick water quality assessment of a waterbody (lake, stream, or wetland). Some of these little critters are very tolerant of polluted waters while others are not. If we find a variety of non-tolerant macro-invertebrates in a waterbody we can assume that there is little to no pollution effecting the ecosystem. However, we must standardize this process in order to compare the health of waterbodies. Below is an equation that helps us do just that.

Field Biotic Index or FBI = Sum[(T)(n)]/N

- T: Tolerance value for a given family/order
- n: Number of individuals found in each family
- N: Total number of individuals in the sample

FBI	Water Quality	Degree of Pollution
0.00-3.5	Excellent	No Apparent
3.51-4.5	Very Good	Possible Slight
4.51-5.50	Good	Some
5.51-6.50	Fair	Fairly Significant
6.51-7.50	Fairly Poor	Significant
7.51-8.50	Poor	Very Significant
8.51-10.00	Very Poor	Severe

In this exercise, students will learn about macro-invertebrates and how they are used in determining if our water is clean by simulating field collections.

Grade Level: 5th through 12th grade

Time: 20 – 50 minutes

Skill: Comprehension of a water quality determinations through the surveying, identifying, and assessing of macro-invertebrate families and orders.

Vocabulary: Macro-invertebrates, Field Biotic Index, Taxonomy, and Pollution Tolerance Scale.

Macro-invertebrates - animals that neither possess nor develop a vertebral column.

Field Biotic Index – an index that standardizes the pollution level within a given waterbody by taking into account macro-invertebrate family/order diversity, given pollution tolerances, and total number of invertebrates found.

Taxonomy – branch of science concerned with classification of organisms

Pollution Tolerance– Scale from 1-10 that describes the pollution tolerance of a given family or order. Numbers close to 1 represent organisms that are not tolerant of pollution and numbers close to 10 represent organisms that are tolerant of pollution.

Objectives: After completion of the lesson, students should be able to define a macro-invertebrate and know how to use the Field Biotic Index to assess water quality.

Minnesota Science Standards:

> 5.4.4.1.1 Give examples of beneficial and harmful human interaction with natural systems. *For example:* Recreation, pollution, wildlife management.
>
> 7.4.2.1.1 Explain how the number of populations an ecosystem can support depends on the biotic resources available as well as abiotic factors such as amount of light and water, temperature range and soil composition.
>
> 7.4.4.1.2 Describe ways that human activities can change the populations and communities in an ecosystem.
>
> 9.4.4.1.2 Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity. *For example:* Changing the temperature or composition of water, air or soil; altering the populations and communities, developing artificial ecosystems; or changing the use of land or water.

Plan of Instruction:

1. Ask for two volunteers from the class. These students will be our "Amateur Scientists". Have these students stand apart from the rest of the class.

2. Split the remaining students into two relatively even groups (Each group will represent a different body of water, Pond A & Pond B).

3. Randomly hand out the macro-invertebrate cards labelled A to one group and then randomly handout the cards labelled B to the second group (One card per student).

4. Our "Amateur Scientists" will be assigned a pond (Either A or B).

5. These "Amateur Scientists" will be given 30 seconds to try and tag as many students as possible in their given pond. If they tag a student that student most give them their card. It might be a good idea to set boundaries for the students to play tag in. Otherwise, the "Amateur Scientist" will not be as successful.

6. Have the students compare the different cards that were collected by the "Amateur Scientists"

a. Did they get the same number of cards?
b. Did one pond have a higher diversity (# of different families/orders found)?
c. Did one of the ponds have a higher number of non-tolerant species (i.e. those that have a lower tolerance value)?

7. Either have the students calculate the FBI for each of the ponds or do it for them.

8. Compare the two FBI scores.

    a. Did one pond have a higher score?
    b. Which one do you suspect has more pollution? How do you know?

Please Note: To create a greater difference between the FBI scores of Pond A and Pond B omit the following cards from the game:

- Pond A = one card each of Chloroperlidae, Athericidae, Cordulegastridae, and Aeshnidae; and two cards from Perlodidae.
- Pond B = all Oligochaeta and Hirudinidae cards.

Materials:

Field Biotic Index calculator (excel file) or a standard calculator

One set of Macro-invertebrate cards:

- 20 cards from Pond A.
- 20 cards from Pond B.