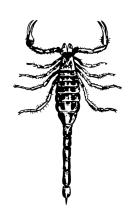# Measuring Water Quality with Biodiversity - CER

DataSet: https://dataclassroom.com/en/dataseteditor/6530

There are many ways to measure environmental quality and the health of an ecosystem. The use of **biological assessment** is often both a practical and powerful way to measure the health of an ecosystem. One common biological assessment used to measure the health of streams and small rivers around the world is sampling **benthic macroinvertebrates**. These bottom (benthos) dwelling animals are large enough to be seen without a microscope (macro) and do not have a backbone (invertebrate). Macroinvertebrate sampling can reveal the physical and or chemical health of streams because the presence of specific animals known to be intolerant to disturbance and pollution can give an overall assessment of ecosystem health.

Macroinvertebrates can be easily sampled in a small stream by wading in shallow water and dragging a handheld net along the bottom. Commonly found animal groups include crustaceans (crayfish, shrimp), insects (mayflies, caddisflies, stoneflies, midges, beetles), worms, snails, and clams. The presence of these small animals is important because it indicates that the water where they are found, as part of the larger **watershed**, is able to support complex food webs from primary producers to larger consumers such as fish.

Mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) are known to be particularly sensitive to pollution and disturbance, and their presence in a stream indicates an ecosystem that can support a diverse community of organisms. The number of such insects is often used to generate a score called the EPT index. In general, a high level of **species richness** (a measure of how many different species live together in one place) indicates an ecosystem that can support ample biodiversity to indicate overall watershed health. If one particular animal group is a highly **dominant taxa** because it makes up a high percentage of all the animals found there, it often indicates that the ecosystem is disturbed or polluted.

Since 1999 the Pennsylvania Department of Environmental Protection (PDEP) has been using the same methods for benthic macroinvertebrate sampling to measure the health of their streams across the state. In addition to sampling the macroinvertebrates, the PDEP and their partners have been collecting data on habitat quality and characteristics of streams like the amount of vegetation along the stream bank, known as a **riparian buffer**, and the fast-moving shallow sections of the stream called **riffles** which increase the oxygen in the water. They use habitat use data like those to compile an overall **Total Habitat Score** where higher numbers indicate a less disturbed waterway.

1. How can benthic invertebrates be used as a measure of the health of a stream?

2. What can species richness tell you about a stream?

3. If an area is sampled and there is only one main type of organism in the stream, what does this tell you about the water quality?

4. How would a riparian buffer be measured?

5. What is the main quality of a riffle?

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You will be working with a dataset collected from streams. The data measures several properties of the stream. Your goal is to investigate a question about the stream by manipulating the dataset.   For each question, you will write a **claim**, provide **evidence** by summarizing the graph and develop a **reasoning** statement.

👌🐌 **Question 1: Does oxygenated water promote biodiversity?**

Background: The **Shannon Diversity Index** was developed to quantify the richness and evenness of a biological community of organisms. Typical values are generally between 1.5 and 3.5 in most ecological studies, and the index is rarely greater than 4. Higher values indicate greater biodiversity.

To answer the question, you will need to use the Shannon Diversity Index numbers for streams.

What other information will you need to answer the question? _____

Procedure:

Open DataClassroom App at https://dataclassroom.com/en/dataseteditor/6530

   In the table view, click on "Shannon Diversity Index" and choose IV (independent variable)
   Click on "Riffle frequency" and choose DV (dependent variable)
   Click on "Graph" at the top menu → The graph will be visible (make sure the "regression line" is checked.)

Consider the experiment question and write a **CLAIM** based on the data shown in the chart.

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Write an **EVIDENCE** statement by summarizing what is shown in the graph. Your summary should include details on the two variables graphed (how does one affect the other?)

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REASONING: Connect the graph evidence to the original question: "Does oxygenated water promote biodiversity?" Your statement should include details about the diversity index and riffle frequency and how those concepts relate to the experimental question. Connect the evidence to the claim.

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✊🏽 Question 2: How does the size of the vegetative zone affect the diversity of the invertebrates in the stream?

Procedure: Use the controls to change the graph to show the vegetative zone on the X axis and diversity index on the Y axis.

Consider the experiment question and write a **CLAIM** based on the data shown in the chart.

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Write an **EVIDENCE** statement by summarizing what is shown in the graph. Your summary should include details on the two variables graphed (how does one affect the other?)

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REASONING: Connect the evidence to the claim.

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✊🏽 Question 3: How does the presence of a species indicate the health of a stream?

Background: Mayfly species are known to be sensitive to water pollution and are therefore an **indicator** of stream health.

Procedure: Use the controls to change the graph to show habitat score (X) and the % intolerant mayfly (Y).

Consider the experiment question and write a **CLAIM** based on the data shown in the chart.

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Write an **EVIDENCE** statement by summarizing what is shown in the graph. Your summary should include details on the two variables graphed (how does one affect the other?)

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REASONING: Connect the evidence to the claim.

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