BIOASSESSMENT OF STREAMS

SUBJECTS:
Biology, Ecology

TIME:
field trip or walk to a stream, then 2 class periods

MATERIALS:
magnifying glasses—one per student, if possible
2 buckets per team
2 hand nets for scooping stream debris
one clipboard & pencil per team
rubber boots for 2 people
student sheets

OBJECTIVES

The student will do the following:

1. Work as a team to gather organisms from a stream to evaluate if the water quality is excellent, good, or fair to poor.

BACKGROUND INFORMATION

The quality of streams can be determined by analyzing macroinvertebrates present. Macroinvertebrates are those organisms lacking a backbone that are visible to the naked eye. In freshwater streams, they include insects, crustaceans (crayfish and others), mollusks (clams and mussels), gastropods (snails), oligochaetes (worms), and others. In most streams and rivers, the larval insects dominate the macroinvertebrate community. These organisms provide an excellent tool for stream quality assessment work because they are restricted to their immediate habitat and cannot escape changes in water quality.

The problems affecting streams can be grouped into three general categories:

1. Physical – stream alterations such as reduced flow or temperature extremes, including excessive sediment input from erosion or construction which unfavorably alters riffle characteristics. The result of physical impacts to a stream range from a general reduction in the numbers of all organisms to a reduction in the diversity of taxa.
2. Organic Pollution and Enrichment – the introduction of large quantities of human and livestock wastes, as well as agricultural fertilizers. Mild organic enrichment usually results in a reduction in diversity, leaving a marked increase in the types and numbers of macroinvertebrates that feed directly on organic materials. Because of the organic enrichment, excessive blooms of algae and other aquatic plants provide a plentiful food supply, favoring algae and detritus feeders.
3. Toxicity – this includes chemical pollutants such as chlorine, acids, metals, pesticides, oil, and so forth. It is very difficult to generalize the effects of toxic compounds upon macroinvertebrates, since a number of the organisms vary in their tolerance to chemical pollutants. Generally speaking, however, a toxicity problem is usually the only condition that will render a stream totally devoid of macroinvertebrates.

Terms

detritus: loose fragments or grains that have been worn away from rock.

macroinvertebrates: organisms that are visible to the naked eye and lack a backbone.

taxa: one of the hierarchical categories into which organisms are classified.

ADVANCE PREPARATION

A. Either schedule a field trip or walk your class to a nearby stream or do the same activity as a classroom simulation, with 3 “streams” that have paper cut-out animals to be found and analyzed.

B. Divide the room into teams of about 10 students each with a team recorder for each group who will need a pencil, clipboard, and “Stream Quality Assessment Form.”

C. Run off copies of the “Stream Quality Assessment Form,” the “Macroinvertebrate Groups” form, and the “Bugs” sheets showing common stream macroinvertebrates.

D. Gather magnifying glasses for the class. The small ones tied around the neck like a necklace work very well.

E. Procure a couple of hand nets to gather stream debris. Procure 2 buckets per group.

F. Make sure those who will be in the stream wear rubber boots. Sometimes it is best for the teacher or a parent to get in the stream and do the actual gathering in the nets. Let the students go through the net contents and find the animals.

G. Contact an environmental scientist (if possible), for help in identifying the animals.

PROCEDURE

I. Setting the stage

A. Pour a glass of “mystery water” (made of sweetened tea) and tell the class this water was collected from a stream near a chemical plant. Ask if you have any volunteers to drink it. If there are no volunteers, drink the whole glass and brag about how delicious it tasted. Then pour a glass of “mystery water” (made of clear saltwater) and ask for a volunteer to taste it. Warn them that you are not sure where it came from and that they had better only take a sip. (One sip will not make anyone sick.)

B. Discuss the problem of determining water quality when the water has not been tested. Ask if the students can think of a way to determine water quality without a water testing kit.

II. Activity

A. Plan a trip to a nearby stream to bioassess the water quality. Each team should have an adult advisor, if possible, to help identify organisms. The “Macroinvertebrate Groups” form will help to identify organisms. Make sure one member of each team serves as a recorder with a clipboard, pencil, and “Stream Quality Assessment Form.” Use the bottom half of the form to tally each animal discovered by a team member.

B. Only one or two people need to get into the stream (in the shallow parts, wearing rubber boots) and use nets to scoop up mud, leaf, and other stream debris. This is emptied out into a bucket in the center of each team, whose members go through it looking for organisms. As they find organisms, they identify them as belonging to group 1, 2, or 3 and are tallied by the team recorder.

C. This process lasts about 45 minutes. The goal is to find 100 organisms for each team, but stream assessment can be accomplished with fewer specimens. The teams do not bring specimens back to the school, although it is interesting to bring back a water specimen to view under the microscope.

D. After returning to school, the class analyzes and compares all team data. If many specimens (over 22) are found from Group 1, the stream is of excellent quality, since these organisms are pollution-intolerant. If there are few or no specimens from Group 1 and 2, and mostly specimens from Group 3, one can assume the stream quality is poor, with only pollution-tolerant organisms able to survive.

III. Follow-Up and Extension

A. Many opportunities exist to teach children about environmental issues after this activity. A few possibilities include cleaning up a poor quality stream, trying to find out the source of pollution and getting it stopped, and assessing other streams.

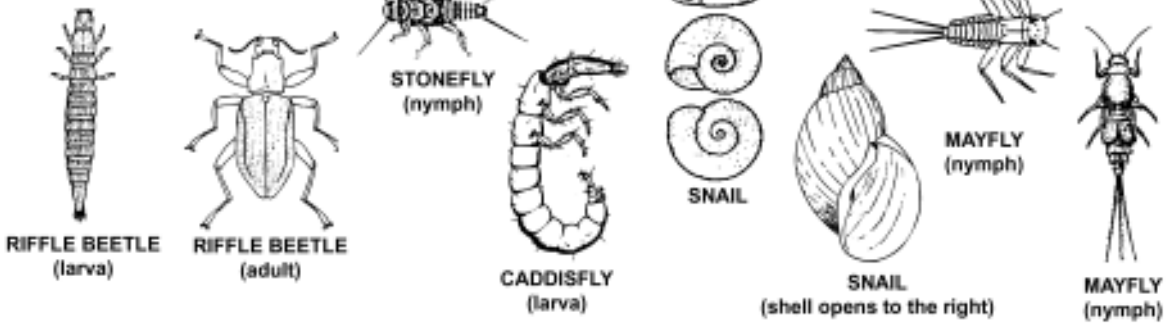
RESOURCES

Kentucky Water Watch. Biological Stream Assessment: http://www.state.ky.us/nrepc/water/introtxt.html

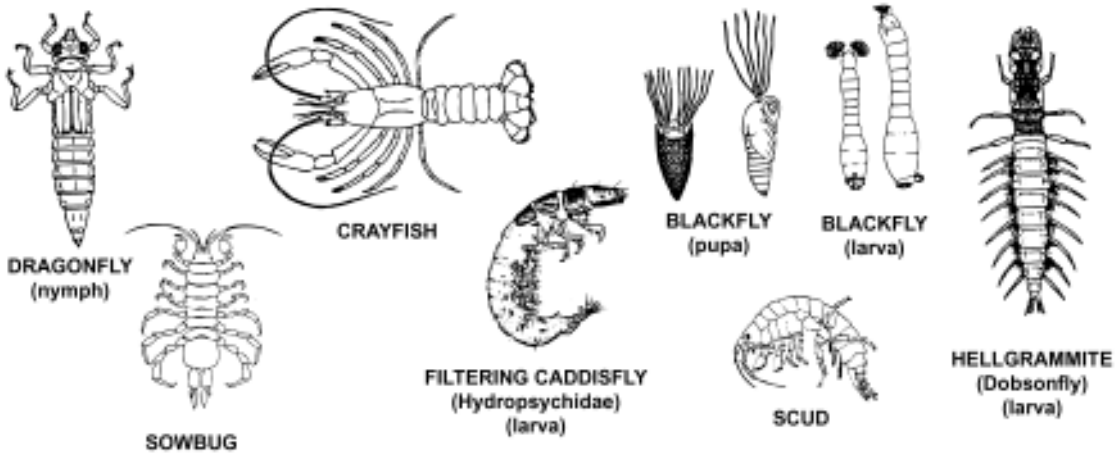
State Water Watch Organizations.

MACROINVERTEBRATE GROUPS
Beginner s Protocol PICTURE KEY

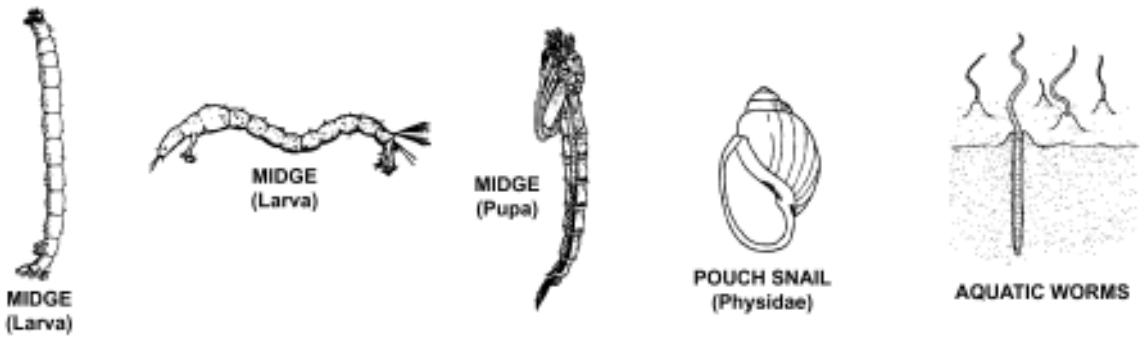
GROUP 1 *These organisms are generally pollution intolerant. Their dominance generally signifies* ***Excellent-Good Water Quality.***



GROUP 2 *These organisms exist in a* ***Wide Range*** *of water quality conditions.*



GROUP 3 *These organisms are generally tolerant of pollution. Their dominance generally signifies* ***Fair-Poor Water Quality.***

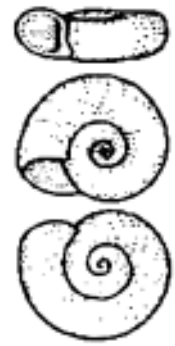


GROUP 1
Bugs

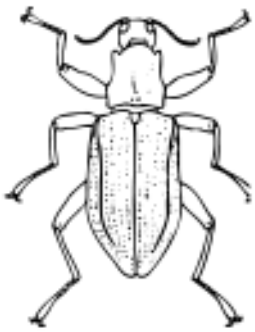
RIFFLE BEETLE
(adult)

RIFFLE BEETLE
(larva)

STONEFLY
(nymph)

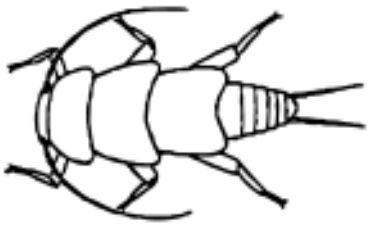


SNAIL



RIFFLE BEETLE
(adult)

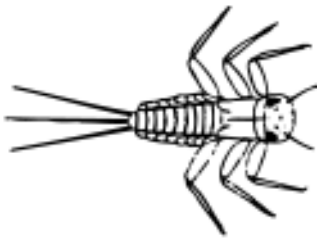
STONEFLY
(nymph)



STONEFLY
(nypmth)

SNAIL
(shell opens to the right)

MAYFLY
(nymph)



MAYFLY
(nymph)

MAYFLY
(nymph)

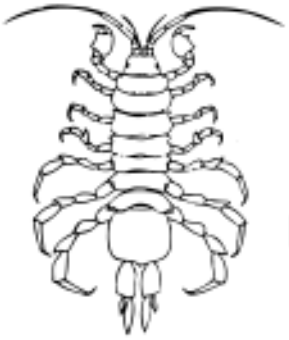
CADDISFLY
(larva)

CADDISFLY
(larva)

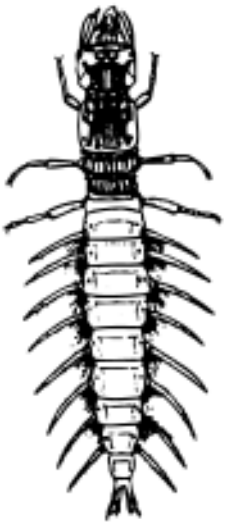
GROUP 2
Bugs

BLACKFLY
(pupa)

BLACKFLY
(larva)



SOWBUG



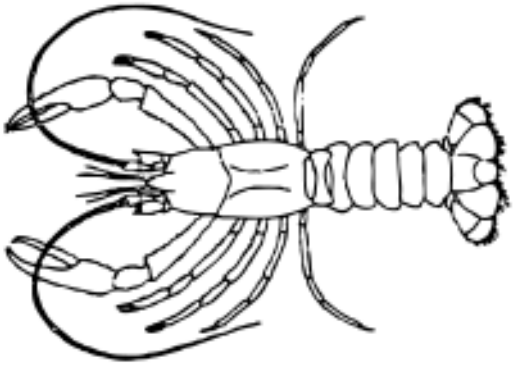
HELLGRAMMITE
(Dobsonfly)
(larva)

DRAGONFLY
(nymph)

SCUD

SNIPE FLY
(larva)

FILTERING CADDISFLY
(Hydropsychidae)
(larva)



CRAYFISH

GROUP 3
Bugs

MIDGE
(Larva)

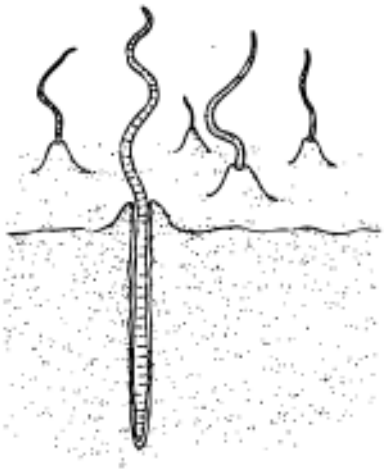
MIDGE
(Larva)

MIDGE
(Pupa)

MIDGE
(Larva)

MIDGE
(Pupa)

MIDGE
(Pupa)



AQUATIC WORMS

SNAIL
(shell opens to the left)

STREAM QUALITY ASSESSMENT FORM

Monitoring Group

Name: _____ Stream Name: _____

Site Location: _____ Date:_____ Time (military):_____

County: _____ Town/City:_____

Organic Substrate Components: _____

Canopy Cover: open partly open partly shaded shaded

Streamside Vegetation type: _____

Turbidity: clear sightly turbid turbid opaque

Water Conditions (color, odor, bedgrowths, surface scum):_____

Chemical Assessment

Please convert ½F to ½C (½C=[½F–32] x 5/9) & feet to centimeters (cm=ft x 30.48)

Air temp ½C:_____ Water temp ½C:_____

Water depth (cm):_____ Secchi Depth (cm):_____

Alkalinity (mg/l):_____ Hardness (mg/l):_____

Dissolved Oxygen (mg/l):_____ pH (SU):_____

Turbidity (JTU):_____

Width of Riffle:_____

Bed Composition of Riffle (%):

Silt:_____
Sand:_____
Gravel (1/4" -2"):_____
Cobbles (2"-10"):_____
Boulders (>10"):_____