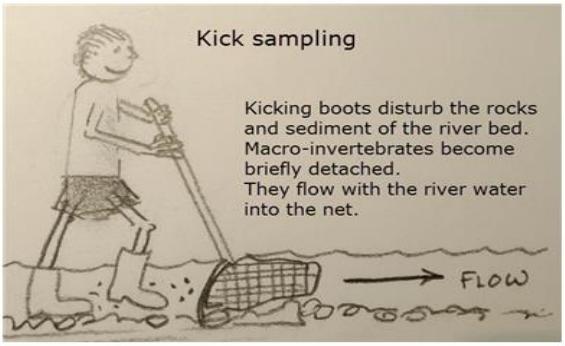
River pollution evaluation using a Biotic Index

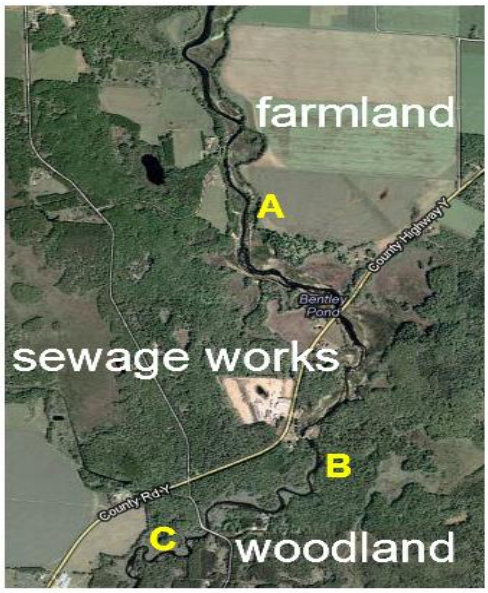
In their research in 2016 a group of IB students carried out a study of invertebrates on a river bed near to their school. They collected three samples of river invertebrates which they called A, B, and C using a standardized kick sampling method.

Aim: to evaluate a claim that the sewage works was polluting the river with organic material.

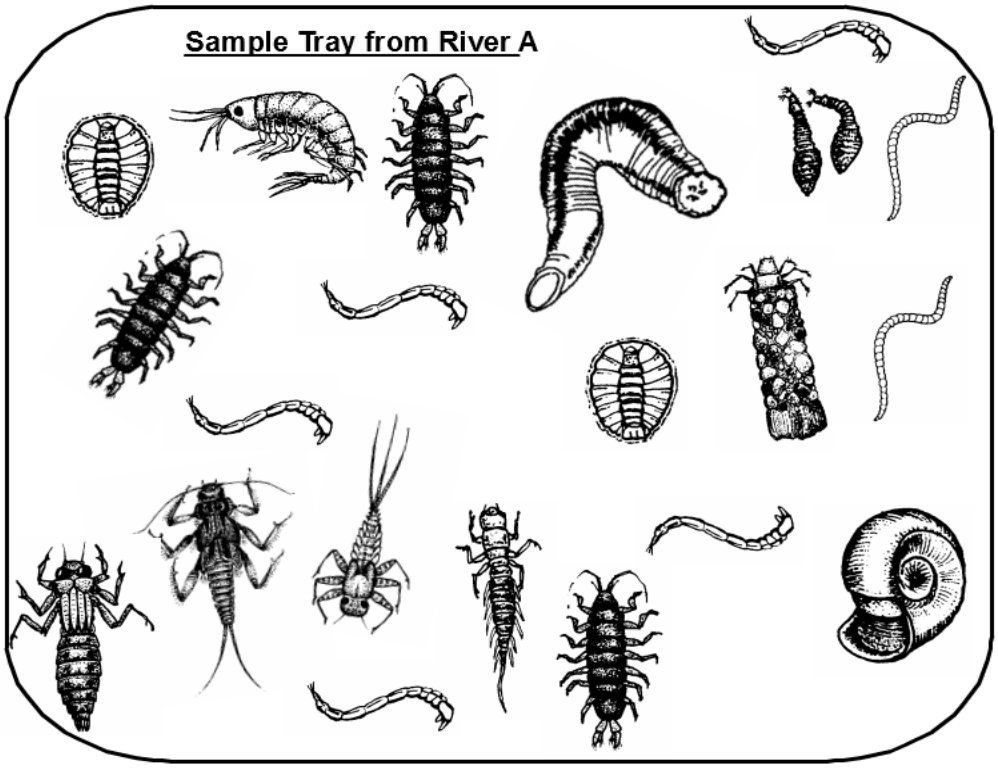
This map shows the location of the three river samples.

A - downstream from farmland
B- next to a sewage works
C - in woodland

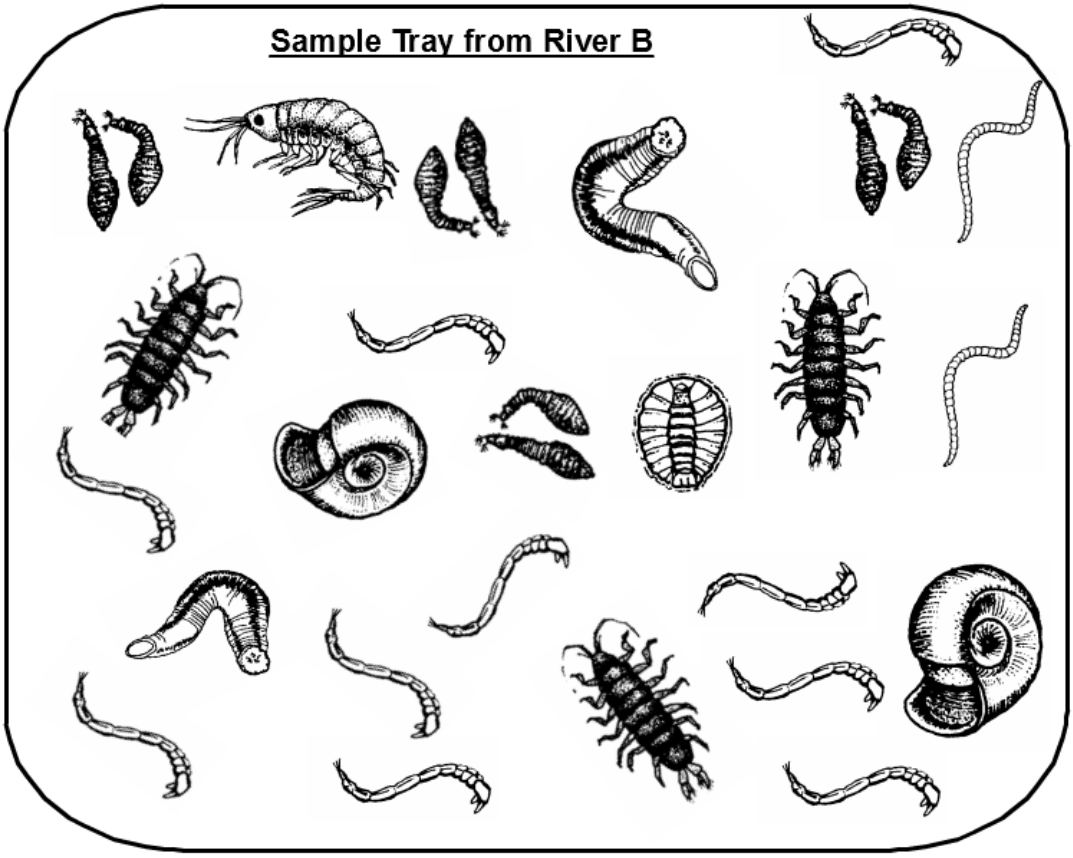




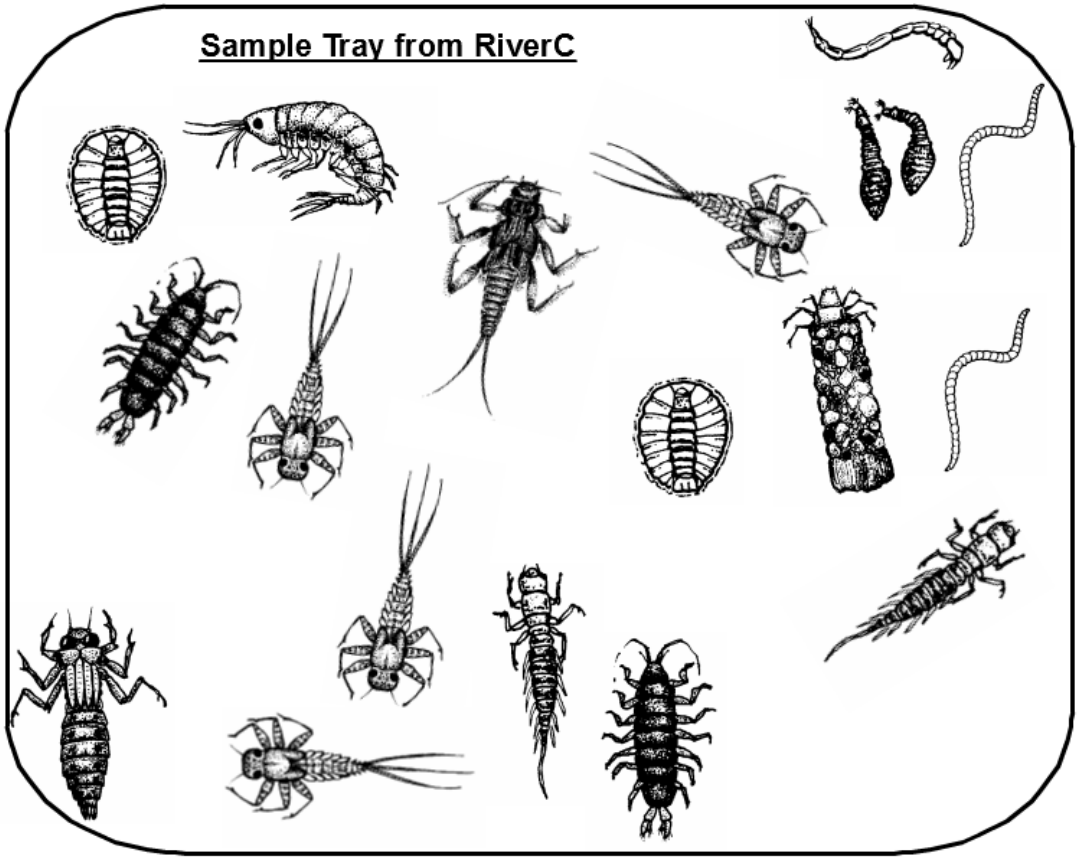
The samples of invertebrates were put into water in white metal trays by the river bank.



Sample Tray from River B



Sample Tray from RiverC



The theory is that organic matter is released from the sewage works. These suspended particles provide food for decomposing bacteria which break down the organic molecules using oxygen from the water. This can lower oxygen levels in the water enough to kill macro-invertebrates, like stonefly larvae, and even kill fish.

Method

1. Identify the species found in each of the trays by annotating the diagram.

2. Complete the following table with the results of the count for each tray.

Marcoinvertebrate	Number counted in tray A	Number counted in tray B	Number counted in tray C	Sensivity to pollution
Stonefly nymph				Class I
Dobsonfly larva				Class I
Alderfly larva				Class I
Watersnipe fly larva				Class I
Caddisfly larva				Class II
Dragonfly nymph				Class II
Crayfish / Crawfish				Class II
Cranefly larva				Class II
Mayfly larva				Class II
Damselfly larva				Class II
Water penny				Class II
Riffle beetle				Class II
Freshwater mussel				Class II
Blackfly larva				Class III
Non-red midge larva				Class III
Snails				Class III
Amphipod / Scud				Class III
Pouch snail				Class IV
Isopod / Sowbug				Class IV
Bloodworm				Class IV
Leech				Class IV
Tubefex worm				Class IV

Biotic Index

To compare the quality of the water at each site ecologists calculate a Biotic index. The method shown here is a simplified Beck Biotic index. It classifies the aquatic insects into four groups depending on their sensitivity to pollution.

First the invertebrates are sorted into categories depending on their response to organic pollution (sewage and other waste which lowers water oxygen levels.

3. Calculate the Biotic index by multiplying the number of animals in each group by the sensitivity factor then adding the values together and dividing by the total number of animals. Use the tables below. The Index value will be between 1 (Poor) and 4 (Excellent).

River sample A

Total number of class I animals _____ x 4 = _____
Total number of class II animals _____ x 3 = _____
Total number of class III animals _____ x 2 = _____
Total number of class IV animals _____ x 1 = _____
TOTAL number or all animals _____ TOTAL of the calculated values _____

Biotic index value = Total calculated values / Total animals = _____

River sample B

Total number of class I animals _____ x 4 = _____
Total number of class II animals _____ x 3 = _____
Total number of class III animals _____ x 2 = _____
Total number of class IV animals _____ x 1 = _____
TOTAL number or all animals _____ TOTAL of the calculated values _____

Biotic index value = Total calculated values / Total animals = _____

River sample C

Total number of class I animals _____ x 4 = _____
Total number of class II animals _____ x 3 = _____
Total number of class III animals _____ x 2 = _____
Total number of class IV animals _____ x 1 = _____
TOTAL number or all animals _____ TOTAL of the calculated values _____

Biotic index value = Total calculated values / Total animals = _____

4. Describe the Biotic index values for each river sample and suggest what this tells us.

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……(2)

5. For interpretation of the river quality ecologist use a scale like the one shown on the right.

Describe the river quality at each point on the map, A, B,and C

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…… (2)

Biotic Index	River quality
1.0 - 1.5	Poor
1.6 - 2.0	
2.1 - 2.5	Fair
2.6 - 3.0	Good
3.1 - 3.5	
3.6 - 4.0	Excellent

6. Evaluate the claim that the sewage works is polluting the river, using the data you have collected.

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……(2)

7. Suggest how organic material might get into the river near farmland.

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……(2)