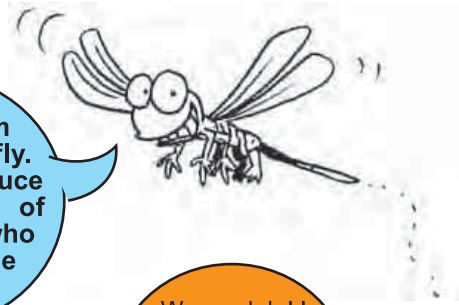
biological monitoring

Global Environment Centre

have you ever wondered what's living inside a river?



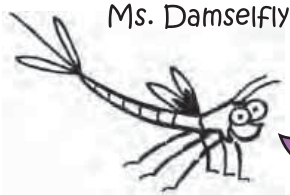
Hi there! I'm Mr. Dragonfly. Let me introduce you to some of my friends who live in the river!

Mr. Whirly Gig

Ooo! Are we having guests? Good luck trying to catch me! I'm really small and I love to whizz around the water!

Wooahh!! What's up D-fly? I'm just skating on the water as usual! You know where to find me!

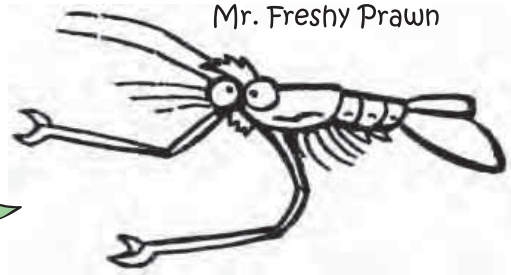
Mr. Skater Waterskater



Ms. Damselfly

Well, helloo! I hope I get to meet you, but you know, this place you're at might not be good enough for me!

Hey! Come join in the party! All of us live together in rivers and it's just one big party 24/7. But remember, help us keep our homes clean!



Mr. Freshy Prawn

introduction

what is biological monitoring?

Biological monitoring is the study of organisms found in our waterways. The type and abundance of these organisms can be used as indicators of water quality because all organisms require specific conditions to live.

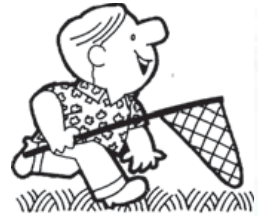
why do we do biological monitoring?

It is a relatively inexpensive and reliable method of acquiring an indication of the water quality and uses simple and inexpensive tools. By identifying 'sensitive' aquatic insects, we can use them as 'bio-indicators' of different levels of water quality. These organisms can provide a relative view of the overall quality of a stream at any given moment.

how do we go about doing biomonitoring?

Depending on the size and length of your river, the roads, trails and weather, you may walk, drive or cycle to do your field work. Be sure you inform your parents, teacher or friend that you are going out to the field and that you have all your field equipment with you!

You'll need:
A hat, shoes/sandals/boots with good grip, a net, a sifting tray, a transparent plastic container, magnifying glasses, pen, paper, camera, identification booklet and a recording sheet.



When you get to your site, remember that you're visiting the home of many animals (including Mr. Dragonfly!). Please be mindful of where you step and please do not throw any rubbish in the area. Always take care of the environment, the animals, plants and yourself!

biomonitoring methods

Make sure you have a container filled with water to place your organisms in before you begin. If you find anything, gently pick it up using forceps or your fingers, or use some water to wash it into the container. Once you have finished, please remember to return the animals back into the water carefully!

peek-a-boo

Good rivers should have rocks, leaves, woody debris and boulders all around, and invertebrates like to hide under them.

1. Find a medium-sized rock/boulder or leaf.
2. Gently pick it up and turn it over to look at the bottom.
3. Observe if there are any movements. You can try trickling some water over the rock to see if anything moves. Once you are finished with the rock, place it back carefully where you found it.

sift away!

1. Use your sifting container to dig up some sand in the river.
2. Bring your sifter up and gently sift through the sand to see if you can find any small organisms within the sand.

what's in the net?

Nets are very useful tools and can be used in several ways.

1. Put your net in perpendicular and against the water flow so that it can catch any fish or organisms that may be swimming in the channel.

2. Hold your net just above the riverbed. Use your feet to kick up some of the sand in front of your net. Lift your net up and see if anything has been caught. If so, release them into the container.

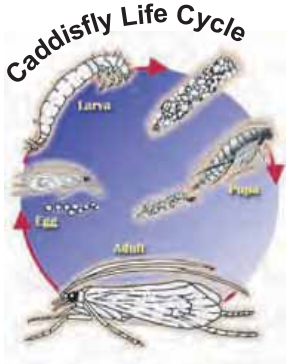
3. Use your net to run through any 'quiet corners' in the river where there are plants growing. Many insects and prawns like to live along the sides of rivers so it is a good place to try and find them.

what do we look for?

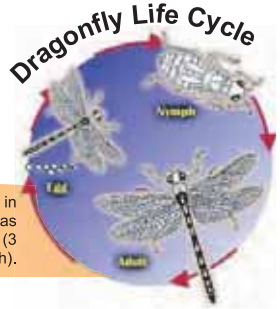
The organisms that live in a waterway are indicators of water quality. We usually look at 2 groups: invertebrates and vertebrates.

Short-term indicators

invertebrates



Invertebrates are animals with no backbones. These can include insects, crustaceans, annelids (worms) and molluscs. Water quality is important to aquatic insects because they breed and live in water. Some terrestrial insects like dragonflies and mayflies lay their eggs in rivers and their young (larvae/nymphs) hatch and live in the water before they become adults. These are very sensitive invertebrates and cannot tolerate poor water quality. However, some invertebrates are very tolerant and can be found in very polluted water. There are even some invertebrates that cannot be used as indicators because they are found everywhere and are not really affected by water quality - they are called 'non-indicator' animals.



Caddisflies represent complete metamorphosis in insects (4 stages or more with larvae), whereas dragonflies represent incomplete metamorphosis (3 main stages of development with nymph).

Long-term indicators

vertebrates

Vertebrates are animals with backbones. In rivers, fish are the most abundant vertebrates. Since they spend their whole lives in the water, they are good indicators of what the water quality has been like over a longer period of time. If there are few fish, it probably means that the water quality has not been good for a long time.

However, you should be aware that there are many different species of fish and some are more tolerant of polluted water than others. In fact, some can tolerate and thrive in very polluted water like *Tilapia*, whereas others require pristine water to survive.

Come look for me! I'll be swimming around!

indicators

Water quality ratings of excellent, good, average and poor are based on the tolerance levels of the organisms found and the diversity of organisms in the sample.

Sensitivity	Range
Very sensitive	can only be found in streams with good water quality
Sensitive	can only be found in streams with good or medium water quality
Moderately sensitive	can be found in streams with good or medium water quality but are also likely to be found in streams of poor water quality
Tolerant	can live in various degrees of water quality and hence can be found across a range of water quality in streams
Non-indicator	mostly found on the surface of the water and are not dependant on the water quality and therefore do not indicate good or bad water quality

key:

sign	indicator	water quality
	very sensitive	excellent
	sensitive	good
	moderate	average
	tolerant	poor
	non-indicator	n/a

biological analytical methods

When one strives to interpret the quality of a stream from its macroinvertebrate population, any or all of the following aspects may be examined:

1. The diversity of organisms in the sample;
2. The percentage of each organism in the sample;
3. The number of organisms per unit area;
4. The sample diversity (the combination of the previous three aspects);
5. The relative pollution tolerances of the organisms in the sample.
6. The various environmental problems of freshwater streams can be detected by these five aspects. The problems affecting streams can be grouped into three general categories:

    - Physical
    - Organic pollution and enrichment
    - Toxicity

There are many ways to calculate the biological richness of our waterways, but the simplest method is to use the **Biological Water Quality Index (BWQI).** Scientists classify animals using a standardized 7-level hierarchy taxonomic rank system:

However, when we use BWQI, the levels have been very much simplified and the animals are classified according to general types and their important features like the number of tails or what kind of gills they have. The method uses a simple scoring system for each animal based on their sensitivity to polluted water. A scoring sheet is located on the back of this booklet for you to use.

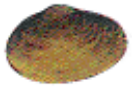
How to use the score sheet. If you find an animal (even if it is only one) in any category, mark its score in the box. You can only count each type once. After you have looked at all your animals, add the scores for each of the boxes, and then take the average by dividing the total score by the number of the animal types you have noted in the table. It is important to calculate an average score as this will reduce any error we may have made from sampling. The result is the Biological Water Quality Index (BWQI).

Use the BWQI to assess the water quality where:

BWQI	Water Quality
7.6 - 10	very clean water
5.1 - 7.5	rather clean - clean water
2.6 - 5.0	rather dirty water - average
1.0 - 2.5	dirty water
0 - 0.9	very dirty water

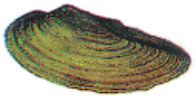
molluscs

pea cockle (3)



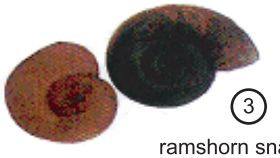
mystery snail (3)

pagoda snail (3)



swan mussel (6)

pond snail (3)



ramshorn snail (3)

worms

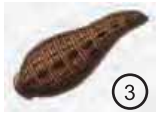
hairworms
(no segments & tentacles)

✻ (5)

flatworms (5)

worm
(long & thin with > 15 segments)

☹ (1)



leeches (3)

small animals ✻ (5)

water fleas

water mite

springtails

larvae

1. caddis fly larvae

cased - caddis fly larvae (10)

common net-spinner (5)

long-headed caddisfly

caseless caddis fly (10)

2. moth larvae ✻ (5)

3. alder fly larvae (4)

4. dobsonfly larvae (9)

5. beetle larvae (5)

water penny larva

riffle beetle larva

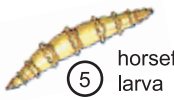
diving beetle larva

whirlgig beetle larva

6. fly larvae


(2) non-biting midge larva


(5) blackfly larva


(5) horsefly larva


(5) midge pupa


cranefly larva (5)


phantom midge larva (5)


mosquito larva (5)


(5) biting midge larva


rat-tailed maggot (3)

legged animals

1. water spiders/mites (8 legs) ✻


water spider


water mite

2. freshwater hoglouse

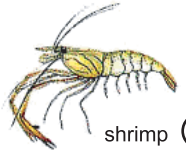

(3)

3. crabs


waterfall crab


river crab (3)

4. freshwater prawns


shrimp (4)


river prawn (8)

important tails

1. one tail

dragonfly nymphs (6)

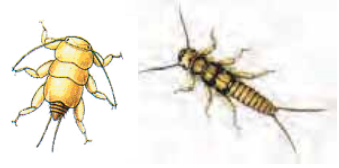

one-tailed dragonfly


common dragonflies

alderfly larvae (4)

2. two tails

stonefly nymphs (10)



damselfly (6)


two-tailed demoiselle

3. three tails

damselfly (no gills) (6)


common damselfly


common demoiselle


balloon-tailed damselfly

biomonitoring score sheet

Date: ..... Site Name: .....
Time: ..... Site Number: .....
Methods: ..... Names: .....
Size of area: ....

Animal	Score
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
Total Score	
Number of animal types	
Biological Water Quality Index	

mayfly (with gills) 10


burrowing mayfly


prong-gilled mayfly

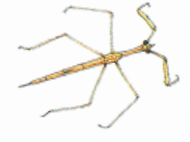

swimming mayfly


spiny crawling mayfly


flattened mayfly

runners and skaters

1. water bugs 5


water stick insect


water scorpion


common saucer bug

2. water boatman 5

lesser water boatman

greater water boatman

3. surface living animals 5


pond skater


water cricket


water measurer


whirlgig beetle