Data Classroom

MACROINVERTEBRATE FIELD GUIDE

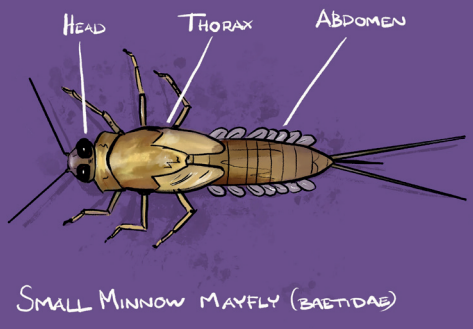
Sample the stream with a net by holding the frame against the bottom and disturbing the bottom of the stream a few feet upstream. You can also sample from vegetation or logs caught in the stream. Also try running your net along vegetation underneath overhanging portions of the bank.

Check your net frequently to look for invertebrates you have collected. Rinse them off and place them into a shallow pan or container for identification. A white or light colored container will work best for easy viewing of the organisms. A magnifying glass can be useful and fun, but is not required.

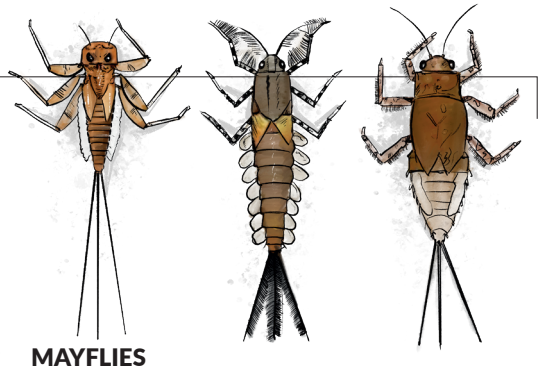
Instructions:
Use this guide to identify the macroinvertebrates you collect in the stream. Remember size and color can vary quite a bit and are affected by things like, time of year, water temperature, diet, and genetic variation, so the best way to identify macroinvertebrates is to look at key morphological features and match them to the illustrations.

The small (m) at the end of some of the texts indicate when multiple kinds may be collected from within the order or class.

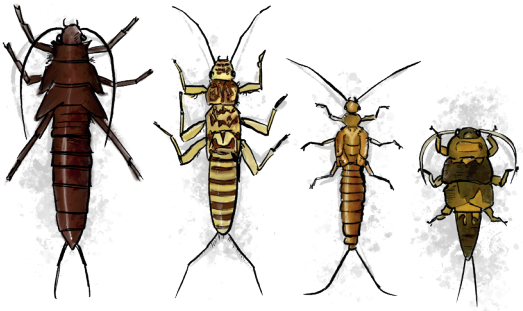
Insect Groups



An insect is a specific type of invertebrate. Its body has three main sections. The **head** is where you find antenna, mouth, and eyes. The middle section, or **thorax**, is where the legs (almost always 3 pairs) and wings connect to the body. The **abdomen** is the section opposite the head end where you will find gills and tail like structures on aquatic insects. The gills you will see on aquatic insects can be thin filaments, plates, or leaf-like structures. Most of the aquatic insects you will find in a stream are actually young insects still in their larval or nymph stages. Most, like mayflies, stoneflies, and dragonflies will leave the water and fly away when they grow into their adult forms.

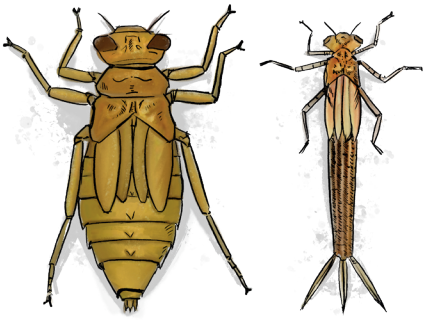


MAYFLIES
Group 1/ Intolerant of Pollution
Mayflies are aquatic insects belonging to the order Ephemeroptera. They have three pairs of legs with a single hook at the end; three - sometimes two - tail filaments; gills attached to the abdomen. The gills may sometimes be covered and difficult to see. Mayflies exhibit several types of movements (or habits); they are swimmers, clingers, crawlers, and burrowers. Families above shown left to right: Heptageniidae (Flatheaded mayfly), Isonychiidae (Brush-legged mayfly), and Ephemerellidae (Spinycrawler mayfly). Size: <5mm – 29mm. (m)



STONEFLIES
Group 1/ Intolerant of Pollution
Stoneflies belong to the order Plecoptera. Their three pairs of legs with two hooks at the end identify them. They have two tail filaments, and no gills attached to the abdomen, but some groups have gills near the top of the abdomen. The gills - if visible - are mostly located on the legs and thorax. The families shown above are from left to right: Pteronarcyidae (Giant stonefly), Perlidae (Common stonefly), Capniidae (Winter stonefly) and Peltoperlidae (Roach-like stonefly). Size: 5mm – >50 mm. (m)

CASE-BUILDING CADDISFLIES
Group 1/ Intolerant of Pollution
The caddisflies, belong to the Trichoptera order. They have a grub-like soft body and a hard head. They have three pairs of legs located on the upper third of the body, and a small tail usually forked. The caddisflies are sometimes fringed with hairs. Their gills are scattered on the underside of the abdomen. The case (retreat) is a relatively solid structure made of a variety of streambed materials held together by silk. Families above shown top down: Brachycentridae (Humpless-case caddisfly), Limnephilidae (Longhorncase caddisfly) and Glossosomatidae (Saddle-case caddisfly). Size: <5mm – 50mm. (m)



DRAGONFLIES AND DAMSELFLIES
Group 2/ Moderately intolerant
Both Dragonflies and Damselflies belong to the Odonata order. They have three pairs of legs, large eyes, long spoon-like jaws, and no tails on the abdomen. Dragonflies (sub-order Anisoptera) have a broad shaped abdomen, while the Damselflies (sub-order Zygoptera) abdomen is much narrower. The gills of the Damselflies are attached to the end of the abdomen; they look like tails. Size: 10mm – >50mm. (m)

Note: The illustrated sizes are not proportional.

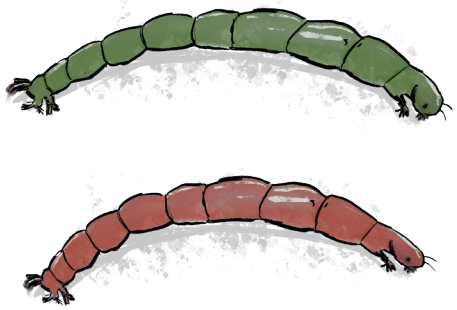
FISHFLIES AND **ALDERFLIES**
Group 1/ Intolerant of Pollution
The Fishflies and Alderflies are part of the Megaloptera order. They can be identified by their three pairs of legs, a large pinching jaw, eight-pairs of filaments attached to the sides of the abdomen. Fishflies (Corydalidae) - also called Hellgrammites - have a two-hooked tail, whereas Alderflies (Sailidae) have a single tapered tail and are usually much smaller and lighter in color. Size: 10mm – >50mm.

NET-SPINNING CADDISFLIES
Group 1/ Intolerant of Pollution
The Net-spinning caddisflies belong to the order Trichoptera. They have the same characteristics as the Case-building caddisflies, but the abdomen usually has more abundant gills; this is especially the case for the Common net-spinning caddisfly. The Net-spinner's retreat is made of a variety of streambed materials loosely held together by fine strands of silk. Free-living caddisfly does not build a case or net. The families shown above are from left to right: Hydropsychidae (Common netspinning caddisfly), and Rhyacophilidae (Free-living caddisfly). Size: 5mm – 50mm. (m)

BEETLES
Group 1/ Intolerant of Pollution
Beetles are a group of insects that form the order Coleoptera. The Coleoptera, with about 400,000 species, is the largest of all orders, constituting almost 40% of described insects and 25% of all known animal life-forms. Beetles typically have a particularly hard exoskeleton and three pairs of legs. The most usually collected beetles are Water penny (Psephenidae), Riffle beetle (Elmidae), and Whirligig beetle (Gyrinidae) but also other adult/larvae beetles are occasionally collected. Size: <5mm – 50mm. (m)

True flies

True flies are insects of the order **Diptera**. Insects of this order use only have one single pair of wings to fly. The body is usually segmented with some visible features either at the head, along the body, or along tail regions. True flies are the only aquatic insect without fully developed legs in the larval stages. They are very diverse order with many aquatic varieties. We have described several common species here.



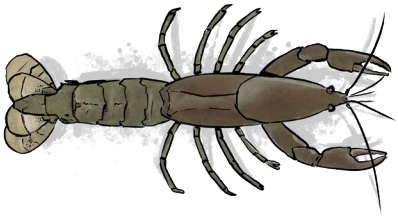
NON-BITING MIDGE
Group 4- Very tolerant of pollution
The Non-biting midge belongs to the Diptera order; Chironomidae. They are tolerant of a wide range of environmental conditions. They are often associated with degraded or low-biodiversity ecosystems because some species have adapted to virtually anoxic conditions and are dominant in polluted waters. They can be identified by their segmented body with a visible head, two leg-like projections at the front and rear. They can vary in color, from green to bright red. Size: <5mm – 29mm.

CRANE FLY
Group 2/ Moderately intolerant of pollution
The Crane larvae belongs to the Diptera order; (Tipulidae). The Crane fly larvae may be green, white or brown in color, and some are so translucent that their internal organs are visible. Crane fly larvae are segmented and appear worm-like, with no legs and no visible head. They have small tentacles, or projections, which are extended if the larvae are handled or squeezed. They vary in size depending on species. Size: 5mm – >50mm.

BLACK FLY
Group 3/ Somewhat tolerant of pollution
The Black fly larvae are part of the Diptera order; (Simuliidae). The larvae use tiny hooks at the ends of their abdomens to hold on to the substrate, using silk holdfasts and threads to move or hold their place. They are highly sensitive to water pollution. They have foldable fans surrounding their mouths. The fans expand when feeding, catching passing debris (small organic particles, algae, and bacteria). The ody is wider at the lower than the upper much like the shape of a bowling pin. There are multiple brushes/fans on the head and a ring of hooks on the abdomen. Size: <5mm – 29mm

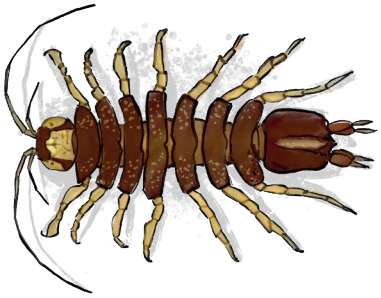
WATERSNIPE FLY
Group 1/ Intolerant of Pollution
The Watersnipe fly also belongs to the Diptera order; (Athericidae). Their head capsule is well developed dorsally, and they have long abdominal prolegs with crocheted hooks. These structures help the larvae move without being washed away in their preferred larval habitat, fast-flowing montane streams, and torrents. The larvae are predators of other aquatic invertebrates such as caddisflies. They have a plump body, quite similar to a caterpillar; on the underside, there are structures that look comparable to legs but are not segmented; the tail is forked and fringed with hairs. Size: 5mm – 50mm.

Non-Insect Groups



CRAYFISH
Group 2/ Moderately intolerant of pollution
Class Crustacea; (order Decapoda). Crayfish are freshwater crustaceans resembling small lobsters (to which they are related). They breathe through feather-like gills. Some species are found in brooks and streams where freshwater is running, while others thrive in swamps, ditches, and paddy fields. Most crayfish cannot tolerate polluted water. Crayfish have five pairs of legs; the first two usually have large claws. They have a large flipper-like structure at the end of the abdomen. Size: 10mm – >50mm. (m)

SCUD/SIDE SWIMMER
Group 2/ Moderately intolerant of pollution
Scud and Sideswimmers are of the class Crustacea; in the Amphipoda order. The Scud and Sideswimmer have two pairs of antennae; they lack a carapace (a covering "back" like a crayfish has). Their eyes are not on stalks, and they have several body segments with legs, gills, and other appendages. They look quite similar to the sowbugs, but unlike sowbugs, their arched bodies are flattened sideways, like shrimp, and the gills arise on the thorax segments (not on the abdomen). They have seven pairs of legs, the first two may be claw-like. The body is somewhat higher than it is wide. Usually swims with a sideways motion - hence the name. Size: 5mm – 29mm.

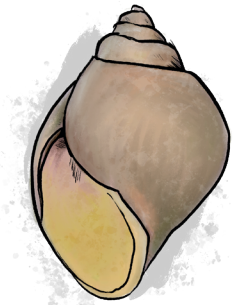


AQUATIC SOWBUG
Group 2/ Moderately intolerant of pollution
The Sowbug is part of the Crustacea class in the Isopoda order. They have seven pairs of legs, the first two may be claw-like. They have two pairs of antennae, one pair is much larger than the other. Their head has big visible chewing mouthparts. Their body is divided into two body segments (cephalothorax and abdomen) with armor-like plates on it. They are usually brown, gray or dark green. Size: 5mm – 29mm.

OPERCULATE SNAILS

Group 1/ Intolerant of Pollution

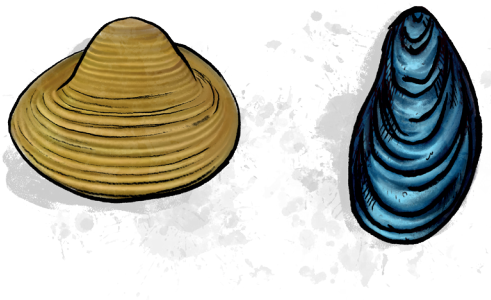
Operculate snails belong to the Gastropoda class with in the Prosobranchia sub-class. Operculate actually means "little lid." The operculum is an anatomical structure like a trapdoor attached at the ending of the columellar muscle with an opercular disc dorsally to the upper surface of the posterior part of the foot. The operculate snail has a fleshy body enclosed by a single shell, which is usually coiled in an upward spiral. The operculum grows in size as the shell grows, such that the operculum remains in proportion to the apertural size. In many species, when the animal is active and crawling, part of the underside of the shell rests on the outer surface of the operculum. Size: <5mm – 50mm. (m)



NON-OPERCULATE SNAILS

Group 4/ Very tolerant of pollution

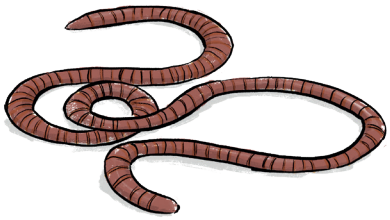
Non-operculate snails are also part of the Gastropoda (snails) class but within the Pulmonata sub-class. Non-operculate means that the opening of the shell is not covered by an operculum. The whorls of the shell do not distinctly bulge out to the sides. Often the shells of most kinds are shaped like a low flat cone or coiled flat instead of being extended in a spiral shape. The typical size range for most snails is <5mm – 50mm, which includes the shell. (m)



CLAMS AND MUSSELS

Group 2/ Moderately intolerant of pollution

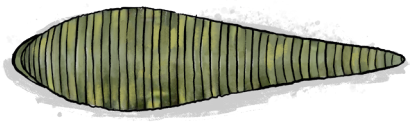
Both Clams and Mussels belong to the Bivalvia class. Freshwater mussels are among the most endangered organisms in North America. They have a soft body that is protected by a hard shell having two hinged halves or valves. Growth lines on shell relate to age; each growing season is marked by the space between two growth lines; there may be several growing seasons within a year's time. You can use the shape and ridge spacing of the shells to determine different kinds. Mussels are usually larger than Clams and have dark-colored oblong shells. Size: <5mm – >50mm. (m)



AQUATIC WORMS

Group 4/ Very tolerant of pollution

Aquatic worms are in Phylum Annelida order and belongs to the Oligochaeta class. They consume small bits of organic matter and sometimes mud. Aquatic worms, much like earthworms, are hermaphrodites. These worms breathe through their skin and also have the ability to regenerate. Aquatic worms generally live in or on the substrate. It has no visible head or tail, and the body is long with numerous segments along its entire length. Size: <5mm – >50mm.



LEECHES

Group 3/ Somewhat tolerant of pollution

Just like the Aquatic worms, the Leeches are in the Phylum Annelida order too, but in the Hirudinea class. They have soft, muscular, segmented bodies that can lengthen and contract. Leeches have suckers at both ends and external annulations that do not correspond with their internal segmentation. The majority of leeches live in freshwater habitats, while some species can be found in terrestrial and marine environments. Their body is long and thin or slightly widened. They have 34 segments along its length, but it often looks like there are many more. Size: 5mm – >50mm.

FLATWORMS

Group 3/ Somewhat tolerant of pollution

Flatworms belong to the Turbellaria class. They are also called platyhelminth. They are a group of soft-bodied, usually much-flattened invertebrates. They are bilaterally symmetrical (i.e., the right and left sides are similar). Flatworms lack specialized respiratory, skeletal, and circulatory systems. They have no body cavity, and the body is not segmented. The Flatworms' head has a triangular shape with eyes on top, which give the animal a cartoonish cross-eyed appearance. Size: <5mm – 50mm.

POLLUTION TOLERANCE

Data Classroom

ENVIRONMENTAL CONDITIONS GRADIENT

GROUP 1 INTOLERANT OF POLLUTION		GROUP 2 MODERATELY INTOLERANT OF POLLUTION		GROUP 3 SOMEWHAT TOLERANT OF POLLUTION		GROUP 4 VERY TOLERANT OF POLLUTION	
MAYFLIES	✓	DRAGONFLIES AND DAMSELFLIES	✓	DRAGONFLIES AND DAMSELFLIES		NON-BITING MIDGE	✓
STONEFLIES		NET-SPINNING CADDISFLIES	✓	BLACK FLYCRAYFISH	✓	NON-OPERCULATE SNAILS	
CASE-BUILDING CADDISFLIES		CRANE FLY		LEECHES	✓	AQUATIC WORMS	
FISHFLIES AND ALDERFLIES	✓	CRAYFISH	✓	FLATWORMS			
BEETLES	✓	SCUD/SIDE SWIMMER	✓				
WATERSNIPE FLY		AQUATIC SOWBUG	✓				
OPERCULATE SNAILS	✓	CLAMS AND MUSSELS					
NUMBER OF TAXA	4	NUMBER OF TAXA	5	NUMBER OF TAXA	2	NUMBER OF TAXA	1

How to calculate a Macroinvertebrate Pollution Tolerance Index

Total up the number of taxa (kinds of animals not individual animals) that you find in each pollution tolerance group.

A Record Taxa Totals:

Group 1	Group 2	Group 3	Group 4
# of taxa = ?	# of taxa = ?	# of taxa = ?	# of taxa = ?

B Calculated Weighted Taxa Values:

Group 1	Group 2	Group 3	Group 4
# of taxa X 1 = ?	# of taxa X 2 = ?	# of taxa X 3 = ?	# of taxa X 4 = ?

C Calculate Total Weighted Taxa Score

Sum the 4 weighted values from each group in B.

D Total number of Different Taxa

Sum the total for all 4 groups in A.

E Calculate Pollution-Tolerance Index (PTI) for the sample

Total Weighted Taxa Score (from C) / Total number of Different Taxa (from D) = PTI

Pollution-Tolerance Index (PTI)	Water Quality
1.0 – 2.0	Excellent
2.1 – 2.5	Good
2.6 – 3.5	Fair
> 3.6	Poor

POLLUTION TOLERANCE - PRINTOUT

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GROUP 1 INTOLERANT OF POLLUTION	
MAYFLIES	
STONEFLIES	
CASE-BUILDING CADDISFLIES	
FISHFLIES AND ALDERFLIES	
BEETLES	
WATERSNIPE FLY	
OPERCULATE SNAILS	
NUMBER OF TAXA	

GROUP 2 MODERATELY INTOLERANT OF POLLUTION	
DRAGONFLIES AND DAMSELFLIES	
NET-SPINNING CADDISFLIES	
CRANE FLY	
CRAYFISH	
SCUD/SIDE SWIMMER	
AQUATIC SOWBUG	
CLAMS AND MUSSELS	
NUMBER OF TAXA	

GROUP 3 SOMEWHAT TOLERANT OF POLLUTION	
DRAGONFLIES AND DAMSELFLIES	
BLACK FLYCRAYFISH	
LEECHES	
FLATWORMS	
NUMBER OF TAXA	

GROUP 4 VERY TOLERANT OF POLLUTION	
NON-BITING MIDGE	
NON-OPERCULATE SNAILS	
AQUATIC WORMS	
NUMBER OF TAXA	