

WV SAVE OUR STREAMS GUIDE TO AQUATIC MACROINVERTEBRATES



West Virginia Department of Environmental Protection
Save Our Streams Program

Introduction

This document is designed to assist volunteer monitors with the identification of many aquatic invertebrates found in our rivers, streams and wetlands. General information is included about the distinguishing features of the aquatic stage that aid in identification. Also included are the organisms, habit, feeding group, tolerance rating, size range, and habitat preferences. Adult information is provided for the order Coleoptera. Additionally, an explanation of functional feeding groups, a glossary and a reference section is included. Most of the images are courtesy of the [Cacapon Institute](#); Jennifer Gillies artist.

Note: Many of the words that may be unfamiliar are defined using on-line dictionaries. The credibility of the web pages included here has not been thoroughly investigated. Apply the normal standards of Internet research to your investigation of each website in order to determine its veracity. Note: Not all families are included here.

Aquatic invertebrates are excellent indicators of watershed health because they:

- Live in the water for all or most of their life
- Stay in areas suitable for their survival
- Are easy to collect
- Differ in their tolerance to amount and types of pollution
- Are easy to identify in a laboratory and in the field with practice
- Often live for more than one year
- Have limited mobility
- Are integrators of environmental conditions
- Are important components of a streams food-web system, especially headwater streams

Habitat preferences

- (F) Fast-moving waters with rocky substrate (i.e. riffles and runs of streams and rivers)
- (S) Slow-moving or still waters with soft substrate and vegetation (i.e. pools and backwater areas of streams and rivers; wetlands and ponds)

Size range categories (mm)

Very large	Large	Medium	Small	Very small
> 50 (VL)	50 – 30 (L)	29 – 15 (M)	14 – 5 (S)	< 5 (VS)

General	Kingdom
	Phylum
	Class
	Order
	Family
	Genus
Specific	Species

Classification: Plants and animals are classified according to a hierarchal system that arranges the organisms into groups based upon their similarities. These groups are arranged from general to very specific. The science of classification is known as taxonomy. The table provides the basic taxonomic groups. In certain situations these major groups are subdivided. This occurs when a group of organism is different enough to be noted but not different enough to place them in a separate classification.

Stress tolerance is the organism's ability to withstand a certain amount of anthropogenic influences. The index range for each category is based upon a (0-10) scale, which is based mostly on the invertebrate's ability to tolerate varying levels of dissolved oxygen and other chemical and physical disturbances. For example, invertebrates with a low tolerance need adequate dissolved oxygen and chemical and physical stability, while those with a high tolerance can survive for a period of time when dissolved oxygen levels are less than adequate or other disturbances may be present. In some cases tolerance values are undetermined (U).

Low (L)				Moderate (M)				High (H)			
0	1	2	3	4	5	6	7	8	9	10	

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Insect Groups

Order *Ephemeroptera* (Mayflies)



Wing pads may be present on the thorax; three pairs of segmented legs attach to the thorax; one claw occurs on the end of the segmented legs; gills occur on the abdominal segments and are attached mainly to the sides of the abdomen, but sometimes extend over the top and bottom of the abdomen; gills consist of either flat plates or filaments; three long thin caudal (tails filaments) usually occur at the end of the abdomen, but there may only be two in some kinds.

Swimming mayflies

1. *Ameletidae* (Ameletid minnow mayfly): Comb of stiff spines on the mouthparts; gills have a dark, sclerotized (hard) band along the outside edge; antennae are shorter than twice the width of the head; usually have dark bands on the tail and alternating dark and light on the abdomen. Swimmer/clinger; Collector/gatherer; (L) VS-M (F)
2. *Baetidae* (Small minnow mayfly): Antennae two times longer than the width of the head; gills variable in shape and attached at abdominal segments one through seven; two or three caudal (tail) filaments. Swimmer; Collector/gatherer; (M) VS-M (F/S)
3. *Isonychiidae* (Brush-legged mayfly): Forelegs have a double row of setae (hairs); gills oval shaped and present on abdominal segments one through seven; long hairs on the margins of the caudal filaments. Swimmer/crawler; Collector/gatherer; (L) S-M (F)
4. *Siphonuridae* (Primitive minnow mayfly): Antennae less than two-time the width of the head; gills usually oval shaped and present on abdominal segments one through seven; long setae on the caudal filaments. Swimmer; Collector/gatherer; (L) S-M (F/S)

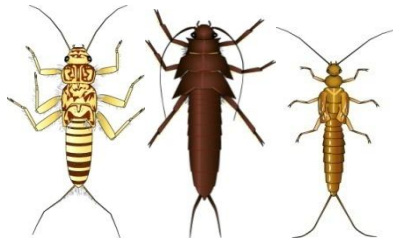
Clinging/crawling mayflies

5. *Caenidae* (Square-gilled mayfly): Gills on the first abdominal segment very small; gills on the second segment operculate (plate-like) covering much of the remaining gills. Clinger/crawler; Collector/gatherer; (M) VS-S (F/S)
6. *Ephemerellidae* (Spiny crawler mayfly): Gills present of the first abdominal segment but absent from the second; gills usually present on the remaining segments; two or three caudal filaments. Clinger/crawler; Collector/gatherer; (L) VS-M (F)
7. *Heptageniidae* (Flatheaded mayfly): Body, head and legs are flattened (femora); gills present on abdominal segments one through seven; usually three caudal filaments, but some may have two. Clinger; Scraper; (L) S-M (F)
8. *Leptophlebiidae* (Prong-gilled mayfly): Gills on abdominal segments two through seven forked and variable in shape; gills on the first segment finger-like; short hairs usually cover the caudal filaments. Clinger/crawler; Collector/gatherer; (L) VS-M (F)
9. *Tricorythidae* (Stout crawler mayfly): Gills absent from abdominal segment one; gills on segment two are (operculate), plate-like triangular or oval shaped and conceals gills on segments three through six. This family is similar in appearance to Caenidae. Clinger/crawler; Collector/gatherer; (M) VS-M (F/S)

Burrowing mayflies

10. *Beatiscidae* (Armored mayfly): Top portion of the thorax is fused and covers most of the abdomen concealing the gills; caudal filaments are short and fringed with hairs. Burrower/crawler; Collector/gatherer; (M) VS-M (F)
11. *Ephemeridae* (Burrowing mayfly): Has upturned mandibular tusks; head and front legs slightly widened and are used for burrowing; gills on the upper abdominal segments are small and the remaining gills are forked with fringed margins (feathered) and held over the top and sides of the abdomen. Burrower; Collector/gatherer; (M) M-L (S/F)
12. *Potamanthidae* (Hackle-gilled mayfly): Mandibular tusks present; front legs slender, not modified for burrowing; gills on segment one small, gills on remaining abdominal segments are feathery. Burrower; Collector/gatherer; (M) S-M (S/F)

Order *Plecoptera* (Stoneflies)



Long thin antenna project in front of the head; wing pads usually present on the thorax but may only be visible in older larvae; three pairs of segmented legs attach to the thorax; two claws are located at the end of the segmented legs; gills occur on the thorax region, usually on the legs or bottom of the thorax, or there may be no visible gills (usually there are none or very few gills on the abdomen); gills are either single or branched filaments; two long thin tails project from the rear of the abdomen. Stoneflies have very low tolerance to many insults; however, several families are tolerant of slightly acidic conditions.

Winter stoneflies

1. *Capniidae* (Small winter stonefly): Slender elongated body; front of thorax slightly wider than the abdomen; wing pads not divergent from the midline; abdominal segments separated by a membranous fold. Clinger/ crawler; Shredder; (L) S-M (F)
2. *Leuctridae* (Rolled-wing stonefly): Slender elongated body; front of thorax slightly wider than the abdomen; wing pads not divergent from the midline; abdominal segments not separated by a membranous fold. Very similar characteristics to Capniidae. Clinger/crawler; Shredder; (L) S-M (F)
3. *Taeniopterygidae* (Winter stonefly): Stout bodies with pronotum much wider than the abdomen; wing pads greatly divergent from the midline. Clinger/crawler; Shredder/scraper; (L) S-M (F)

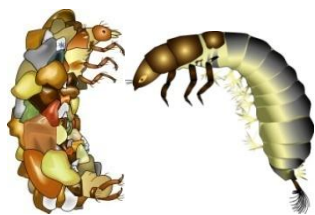
Patterned stoneflies

4. *Chloroperlidae* (Green stonefly): Body elongated, front of the thorax slightly wider than the abdomen; wing pads not divergent from the midline; tails (cerci) shorter than the abdomen. Will sometimes have patterns similar to Perlodidae. Clinger/crawler; Shredder/predator; (L) M (F)
5. *Perlidae* (Common stonefly): Usually a large strikingly patterned and often having a golden color; finely branched gills present on all thoracic segments; wing pads diverge slightly from the midline. Clinger/crawler; Predator; (L) M-L (F)
6. *Perlodidae* (Perlodid stonefly): Strikingly patterned and colored similar in appearance to Perlidae; hind wing pads divergent; no gills on the thoracic segments. Clinger/crawler; Shredder; (L) M-L (F)

Other stoneflies

7. *Nemouridae* (Little brown stonefly): Very small, often hairy appearance; wing pads diverge greatly from the midline; hind legs as long as the abdomen; gills often present between the head and thorax. Clinger/crawler; Shredder; (L) S-M (F/S)
8. *Peltoperlidae* (Roach-like stonefly): Small stout body; rear divergent wing pads; thoracic segments are oval or triangular shaped and cover much of the upper body; some have fine gills on the front legs. Clinger/crawler; Shredder; (L) S-M (F)
9. *Pteronarcyidae* (Giant stonefly): Very large and usually dark brown in color; finely branched gills on all thoracic segments plus the first two abdominal segments. Clinger/crawler; Shredder; (L) M-VL (F)

Order *Trichoptera* (Caddisflies)



Head has a thick hardened skin; antennae are very short, usually not visible; no wing pads occur on the thorax; top of the first thorax always has a hardened plate and in several families the second and third section of the thorax have a hardened plate; three pairs of segmented legs attach to the thorax; abdomen has a thin soft skin; single or branched gills on the abdomen in many families, but some have no visible gills; pair of prolegs with one claw on each, is situated at the end of the abdomen; most families construct various kinds of retreats consisting of a wide variety of materials collected from the streambed.

Net-spinning caddisflies

1. *Hydropsychidae* (Common netspinner): Top of all thoracic segments hardened; most abdominal segments have tufts of finely branched gills; anal prolegs terminate into a brush of hairs. Do not make cases but instead creates a retreat (net) made of a variety of materials held together by fine strands of silk. Note: Can be green in color and look similar to Rhyacophilidae. Clinger/crawler; Collector/ filterer; (M) M-L (F/S)

2. *Philopotamidae* (Finger-net caddisfly): Labrum (structure between the mouthparts) is t-shaped and membranous; head capsule large usually bright yellow or cream colored; only first thoracic segment is hardened; abdominal gills usually absent. Builds a long tube or finger-like net. Clinger/crawler; Collector/filterer; (L) M (F)
3. *Polycentropodidae* (Tube-net caddisfly): Labrum is rounded and hardened; only first thoracic segment is hardened; no plates or gills on the abdominal segments. Does not build cases but instead constructs a net that is often in the shape of a long tube. Clinger/crawler; Collector/filterer/predator; (M) S-L (F/S)
4. *Psychomiidae* (Trumpet-net caddisfly): Bottom of thorax is hardened with black edges; middle thoracic segment is swollen and usually larger than the others; has an enlarged hatchet shaped leg segment on the upper legs. Clinger/crawler; Collector; (M) M (F)

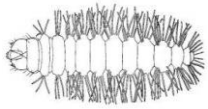
Free-living caddisfly

5. *Rhyacophilidae* (Free-living caddisfly): First thoracic segment is hardened; abdominal gills variable; hardened plate on top of abdominal segment nine; distinctive anal prolegs with large claws; is often green in color. This family does not build a case or net, but often uses silk strands to attach itself to substrates. Clinger/crawler; Predator; (L) M-L (F)

Case-building caddisflies

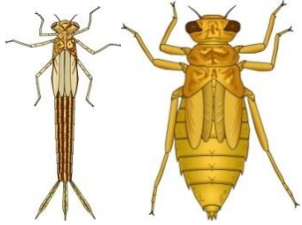
6. *Brachycentridae* (Humpless-case caddisfly): Antennae close to the margins of the head capsule; first two thoracic segments with hardened plates; no humps on abdominal segments; gills simple or lacking. Case is elongated and made of strips of materials, resembles a log cabin. Clinger; Collector/gatherer/shredder; (L) M (F)
7. *Glossosomatidae* (Saddle-case caddisfly): First thoracic segment is hardened; hardened plate on top of abdominal segments nine. Case resembles a tortoise shell or saddle. Clinger; Scraper/shredder; (L) VS-M (F)
8. *Goeridae* (Goerid-case caddisfly): Hardened head, yellow to reddish brown colored; large horn-like structure on the thorax. Case is constructed with sand-grains and small pebbles, usually is slightly curved. Clinger; Scraper; (L) VS-M (F/S)
9. *Helicopsychidae* (Snail-case caddisfly): Body is curled; all three thoracic segments are hardened; stout hairs at the end of the third thoracic segment; gills present on anterior abdominal segments. Case resembles a snail shell. Clinger; Scraper; (L) VS-S (F)
10. *Hydroptilidae* (Purse-case caddisfly): All three of their thoracic segments have sclerotized dorsal plates; no gills on the abdomen; most commonly build cases with sand, algae, silk or detritus, but the shapes vary considerably. Clinger/crawler; Scraper; (M) VS-S (F/S)
11. *Lepidostomatidae* (Lepidostomatid-case caddisfly): Antennae located close to the eyes; lateral hump on abdominal segment one; first two thoracic segments hardened; gills simple or lacking; hardened plate on top of abdominal segment nine. Case is usually four-sided built with square pieces of barks and leaves. Clinger/crawler; Shredder; (L) S-M (F)
12. *Leptoceridae* (Longhorn-case caddisfly): Antennae prominent; first two thoracic segments hardened; hind legs are usually longer than the front legs; abdominal gills variable. Cases are built from a variety of materials and vary considerably; the most common is a stone/sand case resembling a long tube. Clinger/crawler; Collector/predator; (L) S-M (F/S)
13. *Limnephilidae* (Northern-case caddisfly): Antennae between the eyes and the mouth; first two thoracic segments hardened; dorsal and lateral humps on first abdominal segment; hardened plate on the top of abdominal segment nine; abdominal gills variable. The cases are built from many kinds of bottom materials and exhibit a wide variety of shapes and sizes. Clinger/crawler; Shredder; (L) S-L (F)
14. *Molannidae* (hooded-case caddisfly): Two-thirds of the top of the thorax is hardened; tarsal claws on the hind legs smaller than the rest and are covered with fine hairs; gills along the abdomen are simple or branched; a hardened plate sits atop abdominal segment nine. The cases are constructed mostly with sand and are shaped like a flattened tube with a hood that extends over the opening of the case. Clinger/crawler; Collector/shredder; (M) S-M (S)
15. *Phryganeidae* (Giant-case caddisfly): Head and portions of the thorax marked with prominent stripes; front part of the thorax hardened; dorsal and lateral humps on abdominal segment one; hardened plate on top of abdominal segment nine. Builds elongated cases out of plant fragments. Clinger/crawler; Collector/predator; (M) M-L (S)
16. *Uenoidae* (Uenoid-case caddisfly): The first two thoracic segments are hardened and there are some small plates on the third; abdominal segment one has a hump, and the anterior margin of their mesonotum is notched on either side; cases variable usually constructed with small stones and sand. Clinger/crawler; Scraper; (L) S-M (F)

Order *Lepidoptera* (Aquatic moth)



Head hardened; a few families have elongated lateral gills; three pairs of segmented legs attach to the thorax; abdomen with prolegs that end in tiny hooks. They often look very similar to terrestrial caterpillars; closely related to Trichoptera. Crawler/burrower; Shredder; (M) S-M (S/F)

Order *Odonata*; sub-orders *Anisoptera* (Dragonflies) and *Zygoptera* (Damselflies)



Dragonflies: Lower lip (labium) is long and elbowed to fold back against the head when not feeding, thus concealing other mouthparts; wing pads are present on the thorax; three pairs of segmented legs attach to the thorax; no gills on the sides of the abdomen; Dragonflies have three pointed structures may occur at the end of the abdomen forming a pyramid shaped opening; bodies are long and stout or somewhat oval. Damselflies have three flat gills at the end of the abdomen forming a tail-like structure and their bodies are long and slender.

Dragonflies

1. *Aeshnidae* (Darner dragonfly): Prementum and papal lobes are flattened; six or seven antennal segments present all of a similar size. Clinger/crawler; Predator; (L) M-VL (S)
2. *Cordulegastridae* (Spiketail dragonfly): Often appear hairy; prementum large, covering much of the underside of the head, usually triangular shaped. Clinger/crawler; Predator; (L) M-L (S/F)
3. *Gomphidae* (Clubtail dragonfly): Body shape variable from long cylindrical to oval and flattened; prementum flattened; third antennal segment large and different from the rest. Clinger/crawler; Predator; (M) M-L (S/F)
4. *Libellulidae* (Skimmer dragonfly): Antennal segments similar in shape and size; prementum and palpal lobes spoon shaped or small and rounded. Crawler/burrower; Predator; (H) M-L (S)

Damselflies

5. *Calopterygidae* (Broadwing damselfly): Lower portion of labium is diamond shaped; first antennal segment longer than all the others together; middle gills shorter than the lateral two; no visible veins on the gills. Clinger/crawler; Predator; (M) M-L (S/F)
6. *Coenagrionidae* (Narrowwing damselfly): Slender but slightly more stout bodied than most damselflies; labium triangular shaped; antennal segments same length; gills same length, veins radiate diagonally. Clinger/crawler; Predator; (H) M-L (S)
7. *Lestidae* (Spreadwing damselfly): Long and slender bodied; labium stalked and spoon shaped; all gills similar in shape with perpendicular veins. Clinger/crawler; Predator; (H) M-L (S)

Order *Coleoptera* (Beetles)



Head has thick hardened skin; thorax and abdomen of most adult families have moderately hardened skin, several larvae have a soft-skinned abdomen; no wing pads on the thorax in most larvae, but wing pads are usually visible on adults; three pairs of segmented legs attach to the thorax; no structures or projections extend from the sides of the abdomen in most adult families, but some larval stages have flat plates or filaments; no prolegs or long tapering filaments at the end of the abdomen. Beetles are one of the most diverse the insect groups, but are not as common in aquatic environments. Most of the adult stages of the families listed here are aquatic or semi-aquatic.

1. *Chrysomelidae* (Reed beetle): The body is soft; three-pairs of segmented legs attached to the thorax and two hooks on the lower end of the abdomen. Crawler; Collector/gatherer; (H) S-M (S)
2. *Dryopidae* (Long-toed beetle): Adults are hard bodied with very short comb-like antennae. The family is similar in appearance to Elmidae. The larva of this beetle is not aquatic but may be found in the splash zone. Clinger/crawler, Shredder; (M) VS-S (S)
3. *Dytiscidae* (Predacious diving beetle): Legs have five-segments and two-claws on the end; abdomen terminates into a pair of filaments. Adults have slender antennae; hind coxa extends posterior dividing the first abdominal segment into two sections. Swimmer/crawler; Predator; (M) VS-VL (S)

4. *Elmidae* (Riffle beetle): Legs with four segments and a single claw; nine abdominal segments some with a cavity that protect the hind gills. Adults are hard bodied, slender sometimes clubbed antennae; the forewings have numerous rows of indentations; legs long compared to body. Clinger/crawler; Scraper/shredder; (M) VS-S (F)
5. *Gyrinidae* (Whirligig beetle): Two claws of each leg, legs with five segments; ten abdominal segments with pairs of lateral filaments. Adult has compound eyes, which appear divided into pairs; antennae clubbed; mid and hind legs paddle-like. Swimmer/crawler; Predator; (M) S-L (S/F)
6. *Haliplidae* (Crawling water beetle): Legs with five segments and a single claw; abdomen terminates into long filaments; some have many long slender filaments along the entire length of the body. Adult antennae are long and slender; forewings have many indentations; legs lined with small hairs for swimming. Swimmer/crawler; Shredder; (H) S-M (S)
7. *Hydrophilidae* (Water scavenger beetle): Large mandibles; legs with four segments and a single claw; end of the abdomen usually blunt. Adult antennae are clubbed with cup-like segments at the base; hind coxae (joined base) do not extend or divide the abdomen. Swimmer/crawler; Predator; (H) VS-VL (S)
8. *Psephenidae* (Water penny): Body flattened with thoracic and abdominal segments expanded so that the legs and head are obscured from above; legs terminate into a single claw. The adult is semi-aquatic, sometimes encountered near the stream. Clinger/crawler; Scraper; (L) VS-M (F)
9. *Ptilodactylidae* (Toe-wing beetle): Legs with four segments and a single claw; abdomen has ventral gills. Very similar in appearance to the Elmidae larva. Clinger/crawler; Scraper/shredder; (M) VS-S (F)

Order *Hemiptera* (True bugs)



The most distinguishing characteristic of the order is the mouthparts that are modified into an elongated, sucking beak. Most adults have hemelytra, which are modified leathery forewings. Some adults and all larvae lack wings; both most mature larvae possess wing pads. Both adults and larvae have three-pairs of segmented legs with two tarsal claws at the end of each leg. Many families are able to also utilize atmospheric oxygen. This order is generally not used for the biological assessment of flowing waters, due to their ability to use atmospheric oxygen. Several families are described.

Surface

1. *Corixidae* (Water boatman): Broad triangular beak; forelegs are scoop-like and fringed with hairs; antennae are short and concealed beneath the eyes. Swimmer; Predator; (H) VS-M (S)
2. *Gerridae/Veliidae* (Water striders): Variable body shape; cylindrical beak; rear legs extend well beyond the tip of the abdomen. Swimmer; Predator; (H) VS-M (S)
3. *Notonectidae* (Backswimmer): Body cylindrical; antennae are short and concealed beneath the eyes; hind legs are oar-like; hind tarsal claws inconspicuous. Swimmer; Predator; (H) M (S)

Sub-surface

4. *Belostomatidae* (Giant water bug): Large oval body; antennae are short and concealed beneath the eyes; raptorial front legs. Swimmer/clinger; Predator; (H) M-VL (S)
5. *Hydrometridae* (Water measurer): Body slender and elongated; antennae longer than the head; head usually longer than the thorax; legs are long and slender, each with two claws. Clinger/crawler; Predator; (H) S-M (S)
6. *Nepidae* (Water scorpion): Body long and cylindrical; antennae are inconspicuous and concealed beneath the eyes; forelegs are raptorial other legs are long and slender; abdomen terminates into a long breathing appendage. Clinger/crawler; Predator; (H) M-L (S)

Order *Megaloptera* (Hellgrammite, Fishfly and Alderfly)



Head and thorax has thick hardened skin, while the abdomen has thin soft skin; prominent chewing mouthparts project in front of the head; no wing pads on the thorax; three pairs of segmented legs attach to the thorax; seven or eight pairs of stout tapering filaments extend from the abdomen; end of the abdomen has either a pair of prolegs with two claws on each proleg, or a single long tapering filament with no prolegs.

1. *Corydalidae* (Hellgrammite): Elongate dorsally flattened body; large jaws on the head, projecting forward; first eight abdominal segments and segment ten with paired lateral filaments; gill-tufts beside/beneath the filaments; abdomen terminates in fleshy appendages bearing hooks. Clinger/crawler; Predator; (L) M-VL (F)
2. *Chaulioidinae* (Fishfly): Elongate dorsally flattened body; large jaws on the head, projecting forward; first eight abdominal segments and segment ten with paired lateral filaments; no gill-tufts; abdomen terminates in fleshy appendages bearing hooks. Clinger/crawler; Predator; (L) M-L (F)
3. *Sialidae* (Alderfly): Elongate dorsally flattened body; large jaws on the head, projecting forward; first seven abdominal segments and segment ten with paired lateral filaments; abdomen terminates into a single long hairy filament. Crawler/burrower; Predator; (M) S-L (S/F)

Order *Collembola* (Springtails)



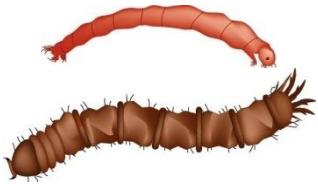
Abdomen consisting of six segments, the first having collophores; abdomen terminates into a forked appendage. Has a habit of jumping on the surface of the water. Swimmer/crawler; Collector/gatherer; (M) VS (S)

Order *Neuroptera* (Spongilliflies)



Antennae long and multi-segmented; jaws long and needle-like; body covered in tiny hairs (seta); has a pair of hardened plates on the thorax and each abdominal segment. They are associated with freshwater sponges, found on the outside or in the canals of the sponge. Clinger; Piercer; (U) VS-S (S)

Order *Diptera* (True flies)



Head may be a capsule-like structure with thick hard skin; head may be partially reduced so that it appears to be part of the thorax, or it may be greatly reduced with only the mouthparts visible; no wing pads occur on the thorax; false-legs (pseudo-legs) may extend from various sections of the thorax and abdomen in some families; no segmented legs in the larval forms; thorax and abdomen composed of entirely soft skin, but some families have hardened plates scattered on various body features. The larval stages do not have segmented legs features.

Midges/mosquitoes

1. *Blephariceridae* (Net-wing midge): Head fused with thorax and first abdominal segment; six abdominal segments with deep constrictions between segments; gill tufts present ventrally. Clinger; Scraper; (L) VS-S (F)
2. *Ceratopogonidae* (Biting midge): Variable characteristics occur in this family, often similar in appearance to Chironomidae; usually a distinct head is visible with small mandibles. Crawler./burrower; Predator; (H) VS-M (F/S)
3. *Chironomidae* (Non-biting midge): Hardened clearly visible head; long worm-like body; two pairs of prolegs with terminal hooks. Some may be red in color due to a hemoglobin-like compound. Crawler/burrower; Collector/gatherer; (H) VS-L (F/S)
4. *Culicidae* (Mosquito): Head hardened and separate from the thorax; brush-like setae near the labrum (upper-lip); thorax is fused and swollen and wider than the abdomen. Swimmer; Collector/gatherer/filterer; (H) VS-M (S)
5. *Dixidae* (Dixid midge): Head hardened and rounded; prolegs terminate in hooks on abdominal segment one and two; abdomen terminates into two lobes fringed with hairs. Crawler/burrower; Collector/gatherer; (M) VS-M (S/F)
6. *Syrphidae* (Rat-tailed maggot): Head blunt or reduced and withdrawn into the thorax; 7 prolegs; abdomen terminates into a very long respiratory tube. Crawler/burrower; Collector/gatherer; (H) VS-M (S)

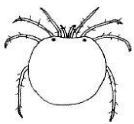
Flies

7. *Athericidae* (Watersnipe fly): Body long (caterpillar-like); head reduced but may be visible; prolegs on most abdominal segments; abdomen ends in a fringed tail. The family is often green in color. Clinger./crawler; Predator; (L) S-M (F)

8. *Empididae* (Dance fly): Body elongated; head reduced or pulled into the thorax; prolegs present on most abdominal segments; prolegs longer on segment eight; abdomen is blunt on the end or terminates in welts. Crawler/burrower; Predator; (H) VS-M (S/F)
9. *Muscidae* (Muscid fly): Anterior portion of the body tapered, posterior is blunt; head reduced or withdrawn into thorax; whelps on abdominal segments; abdomen terminates into a pair of respiratory tubes. Predator; (H) S-M (S/F)
10. *Psychodidae* (Moth fly): Head hardened, rounded and separate from the thorax; body segments with two to three secondary divisions (annuli) often having hardened plates. Burrower; Collector/gatherer; (H) VS-S (S)
11. *Ptychopteridae* (Phantom crane fly): Head hardened and rounded; prolegs present on abdominal segments one through three, terminating with claws; abdomen terminates into a long respiratory tube. Crawler/burrower; Collector/gatherer; (H) M (S)
12. *Simuliidae* (Black fly): Head hardened and rounded bearing a pair of labral fans (mouth brushes); prolegs on lower thorax; lower third of the abdomen is swollen (vase-like) and terminates in a ring of hooks. Clinger; Collector/filterer; (M) VS-M (F)
13. *Stratiomyidae* (Soldier fly): Body is flattened dorsally with a leathery feel; head is reduced but visible; thorax is broader than the head; spiracles at the end of the abdomen for breathing. Swimmer/burrower; Collector/gatherer; (H) S-L (S)
14. *Tabanidae* (Horse fly): Body spindle shape both ends tapered; head reduced usually not visible; creeping welts with small hooks present on abdominal segments one through seven; no prolegs. Crawler, burrower; Predator; (H) M-VL (S/F)
15. *Tipulidae* (Crane fly): Rounded head capsule, often reduced and barely visible; ventral welts on some abdominal segments; abdomen terminates into a disc surrounded by lobes or tentacle-like projections of varying shapes. Crawler/burrower; Shredder/predator; (M) VS-VL (F/S)

Non Insect Groups

Class *Arachnida*; family *Hydrachnidae* (Water mites)



Four-pairs of segmented legs; one-pair of pedipalps; body is rounded and appears to consist entirely of an abdomen without segments. When captured will move very rapidly in a circular pattern. Swimmer/crawler; Predator; (M) S-M (F)

Sub-phylum *Crustacea* (Crayfish, Shrimp, Scuds and Sowbugs)



More than three pairs of legs (> 6) attached to the thorax; the first several pairs of legs may have a hinged claw, which is often enlarged as in the order Decapoda; bodies strongly flattened from top to bottom or from side to side; abdomen consists of individual segments or the segments may be fused to form a thoracic shield; some kinds have a broad flipper on the end of the abdomen.

Order Amphipoda

1. *Gammaridae* (Sideswimmer): Having a shrimp-like appearance; body flattened from side to side; one pairs of antennae of equal length; seven-pairs of walking legs, first two are claw-like the remaining legs are simple. Has a habit of swimming sideways. Crawler/swimmer; Collector/gatherer; (M) S-M (F)

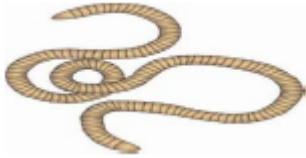
Order Decapoda

2. *Cambaridae* (Crayfish): Body mostly dorsally flattened; two-pairs of antennae one longer than the other; five-pairs of legs, first three-pairs with hinged claws and the first pair of claws are greatly enlarged; abdomen terminates in a flipper-like structure. Crawler/burrower; Collector/gatherer; (M) M-VL (S/F)
3. *Palaemonidae* (Freshwater shrimp): Cephalothorax and abdomen cylindrical with some side-to-side flattening; 5-pairs of walking legs the first two have claws, which are not enlarged; abdomen terminates in a flipper-like structure. Crawler/swimmer; Scraper; (M) M-VL (S)

Order **Isopoda**

4. *Asellidae* (Aquatic sowbug): Body dorsally flattened; two-pairs of antennae one longer than the other; seven-pairs of legs, the first is claw-like and slightly enlarged, and the others have a simple pointed claw. Looks similar in appearance to its terrestrial cousin, the **pill bug**. Crawler/burrower; Collector/gatherer; (H) S-M (S/F)

Phylum *Annelida* (Leeches and Worms)



Body is soft, muscular and cylindrical in shape; body consists of many similar, round ring-like segments arranged in rows; numerous segments along the entire length, number often depends upon the order or family. Leeches have distinct suckers situated on the bottom of the body, one at the front and one at the rear.

Leeches

1. *Hirudinea* (Leech): Body dorsally flattened with 34 segments, which are divided so there appears to be more; suction disks present on one or both ends; eyespots may be present. Crawler/burrower; Predator/parasite; (H) S-VL (S/F)

Worms

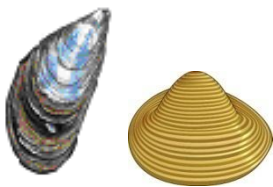
2. *Oligochaeta* (Aquatic worm): Body elongated (worm-like); divided into many segments most having bundles of small hairs; no eyespots or suckers present. Aquatic earthworms are common in riffles; however wetlands have a much wider variety from this group (i.e. **Naidid** worms, **Tubiflex** worms etc.) Crawler/burrower; Collector/gatherer; (H) VS-VL (F/S)
3. *Nematoda* (Round worm): Worm-like; no segmentation; body usually translucent or having a pale coloration. Crawler/burrower; Collector/gatherer; (H) VS-M (S)
4. *Nematomorpha* (Horsehair worm): Body very long and slender; no segments. Burrower; Parasite/predator; (H) VL (S)

Class *Turbellaria* (Flatworms)



Soft-elongated body flattened from top to bottom; no individual segments; digestive track with only one opening which functions both as the mouth and anus; mouth usually on the bottom side positioned about one-fifth to the length of the body; sides of the body constricted towards the front forming a head that is often somewhat triangular shaped; two eyespots situated on top of the head gives the animal a cross-eyed appearance. Most families can withstand high nutrient and organic enrichment, but some are very sensitive to toxics. Crawler/burrower; Collector/gatherer; (H) VS-L (S/F)

Class *Bivalvia* (Clams and Mussels)



Two shells opposite of each other and strongly connected by a hinged ligament; the shell is thick and strong or thin and fragile in some kinds; growth rings on the shell are either far apart and are distinctly raised, or very close together and hardly raised at all; the foot usually consists of two tubular structures that can often be seen protruding from the shell; the body is soft tissue, often pinkish or gray in color.

North American streams, rivers and lakes support the richest diversity of **freshwater mollusks** on the planet. Over 650 species of snails and 300 species of freshwater mussels have been described so far.

Clams

1. *Corbiculidae* (Asian clam): Shell is rounded; brown in color usually lighter than mussels; raised separated ridges along the top and sides of the shell. Clinger/burrower; Collector/filterer; (M) VS-VL (S/F)
2. *Sphaeriidae* (Pea clam): Shell is very small and rounded; light colored; ridges spaced close together, not raised. Clinger/burrower; Collector/filterer; (M) VS-M (S/F)

Mussels

3. *Unionidae* (Mussel): Largest of the bivalves; shell usually dark in color, variable in shape but maybe somewhat oblong; has many indentations and ridges on the tops and sides of the shell. Clinger/burrower; Collector/filterer; (L) VS-VL (S/F)
4. *Dreissenidae* (Zebra mussel): Gets their name from the striped pattern of their shells, though not all shells bear this pattern; usually about fingernail size but can grow to a maximum length of nearly two inches; often they can be found in large colonies attached to a variety of objects. Clinger; Collector/filterer (M) VS-M (S)

Class *Gastropoda*; sub-classes *Prosobranchia* (operculate) and *Pulmonata* (non-operculate) snails



Operculate snails have a flat lid-like structure called an operculum that can seal the body of the snail inside the shell; the whorls of the shell bulge out distinctively to the sides (inflated); most have their opening on the right when the narrow end is held up; shells often extended into a spiral shape. Non-operculate snails have no 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. Typical size range for most snails is VS-L, which includes the shell. For more information visit Marshall University's [Aquatic Snails of West Virginia](#) website.

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Operculate snails

1. *Bithyniidae* (Bithynid snail): Usually a small shell sometimes colored or having a mottled pattern; gills sometimes visible. Clinger/crawler; Scraper; (M) (F/S)
2. *Hydrobiidae* (Pebble snail): Shell is whorled and bulges out to the side (inflated); opens to the right when the narrow end is held up. The family is very diverse in shell size and shape; shell shape can range from conical (cone-like) to spherical (rounded). Clinger/crawler; Scraper; (L) (F)
3. *Pleuroceridae* (Rock snail): Shell is spiraled and whorled but does not bulge out to the side (flattened); opens to the right when the narrow end is held up; operculum is smaller than most others and can be pulled into the shell. Clinger/crawler; Scraper; (L) (F)
4. *Viviparidae* (Viviparid snail): Shell is whorled and bulges out to the side (inflated); opens to the right when the narrow end is held up; operculum has concentric lines, which are slightly off-center. Clinger/crawler; Scraper; (M) (S)

Non-operculate snails

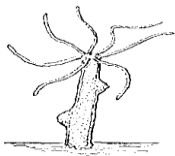
5. *Ancylidae* (Limpet): Shell shaped like a low flat cone; no operculum. Clinger/burrower; Scraper; (H) (F)
6. *Planorbidae* (Orb snail): Shell is coiled flat instead of extended in a spiral; no operculum. Clinger/burrower; Scraper; (M) (S/F)
7. *Physidae* (Pouch snail): Shell is high, spiraled, with a slight bulge; opens to the left when the narrow end is held up; no operculum. Clinger/crawler; Scraper; (H) (S/F)

Class *Hydrozoa* (Freshwater jellyfish)



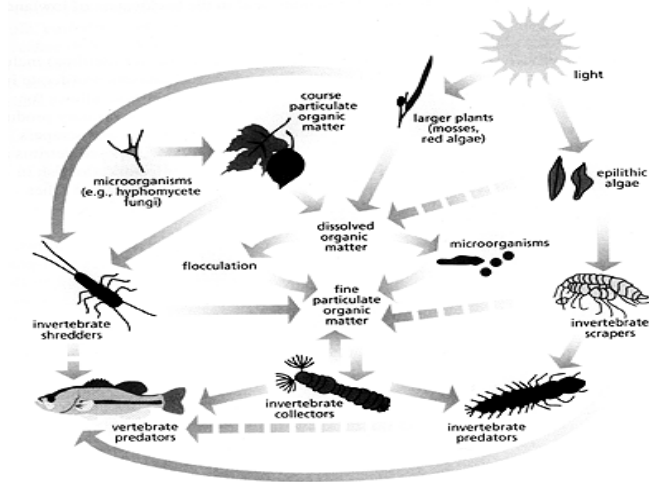
Usually small and bell-shaped; tentacles of varying lengths protrude from the margins of the velum; is often translucent with a whitish or greenish tinge. Swimmer/clinger; Collector/predator; (U) VS-S (S)

Class *Spongilla* (Freshwater sponge)



Sponges are delicate in structure, growing as encrusting or branching masses; usually appear greenish because of the algae that live on them. Freshwater sponges may attain a volume of more than 2,500 cubic centimeters (150 cubic inches). The larva of the Spongilla fly lives as a parasite on freshwater sponges. (U) S-L (S)

Functional Feeding Groups



A **functional feeding group** is a classification approach that is based on behavioral mechanisms of food acquisition rather than taxonomic group. The same general behavioral mechanisms in different species can result in the ingestion of a wide range of food items. The benefit of this method is that instead of hundreds of different taxa to be studied, a small number of groups of organisms can be studied collectively based on the way they function and process energy in the stream ecosystem. Individuals are categorized based on their mechanisms for obtaining food and the particle size of the food, and not specifically on what they are eating. This method of analysis avoids the relatively non-informative necessity to classify the majority of aquatic insect taxa as omnivores and it establishes linkages to basic aquatic food resource categories, coarse particulate organic matter (CPOM), and fine particulate organic matter

(FPOM), which require different adaptations for their exploitation.

The major functional feeding groups are: scrapers (grazers), which consume algae and associated material; shredders, which consume leaf litter or other CPOM, including wood; collectors (gatherers), which collect FPOM from the stream bottom; filterers, which collect FPOM from the water column using a variety of filters; and predators, which feed on other consumers. A sixth category includes species that do not fit neatly into the other categories such as parasites. It is important to keep in mind, however, that many kinds of invertebrates use a variety of food acquisition methods.

Glossary: The **glossary** below includes select terminology used here, and it also includes other terms often associated with the description of aquatic invertebrates. The source of most of these definitions is the publications listed in the reference list below.

Abdomen: The third main division of the body; behind the head and thorax.

Anterior: In front (before).

Apical: Near or pertaining to the end of any structure, part of the structure that is farthest from the body.

Basal: Pertaining to the end of any structure that is nearest to the body.

Burrower: Animal that uses a variety of structures designed for moving and burrowing into sand and silt, or building tubes within loose substrate.

Carapace: The hardened part of some arthropods that spreads like a shield over several segments of the head and thorax.

Caudal filament: Threadlike projection at the end of the abdomen, like a tail.

Clinger: Animal that uses claws or hooks to cling to the surfaces or rocks, plants or other hard surfaces and often moves slowly along these surfaces.

Concentric: A growth pattern on the opercula of some gastropods, marked by a series of circles that lie entirely within each other; compare multi-spiral and pauci-spiral.

Crawler: An animal, whose main means of locomotion is moving slowly along the bottom, usually has some type of hooks, claws or specially designed feet to help hold them to surfaces.

Detritus: Disintegrated or broken up mineral or organic material.

Dextral: The curvature of a gastropod shell where the opening is visible on the right when the spire is pointed up.

Distal: Near or toward the free end of any appendage; that part farthest from the body.

Dorsal: Pertaining to, or situated on the back or top, especially of the thorax and abdomen.

Elytra: Hardened shell-like mesothoracic wings of adult beetles (Coleoptera).

Femur: The leg section between the tibia and coxa of Arthropoda, comparable to an upper arm or thigh.

Flagellum: A small fingerlike or whip-like projection.

Gill: Any structure especially adapted for the exchange of dissolved gases between animal and a surrounding liquid.

Glossae: A lobe or lobes front and center on the labium; in Plecoptera, the lobes are between the paraglossae.

Hemimetabolism: incomplete metamorphosis.

Holometabolism: complete metamorphosis.

Labium: Lower mouthpart of an arthropod, like a jaw or lip.

Labrum: Upper mouthpart of an arthropod consisting of a single usually hinged plate above the mandibles.

Lateral: Feature or marking located on the side of a body or other structure.

Ligula: Forming the ventral wall of an arthropod's oral cavity.

Lobe: A rounded projection or protuberance.

Mandibles: The first pair of jaws in insects.

Maxillae: The second pair of jaws in insects.

Multi spiral: A growth pattern on the opercula of some gastropods marked by several turns from the center to the edge.

Operculum: A lid or covering structure, like a door to an opening.

Palpal lobes: The grasping pinchers at the end of the Odonata lower jaw.

Pauci-spiral: A growth pattern on the opercula of some gastropods marked by few turns from the center to the edge.

Periphyton: Algae and associated organisms that live attached to underwater surfaces.

Posterior: Behind; opposite of anterior.

Proleg: Any projection appendage that serves for support locomotion or attachment.

Prothorax: The first thoracic segment closest to the head.

Rostrum: A beak or beak-like mouthpart.

Sclerite: A hardened area of an insect body wall, usually surrounded by softer membranes.

Seta (pl. setae): Hair like projection.

Sinistral: The curvature of a gastropod shell where the opening is seen on the left when the spire is pointed up.

References and Recommended Reading

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