



**West Virginia Department of Environmental Protection
Division of Water and Waste Management
Watershed Improvement Branch
Save Our Streams Program**



**WV Save Our Streams
Field Guide to Aquatic
Invertebrates**

This guide is designed to assist more experienced volunteer monitors with field identification of macroinvertebrates found in our rivers, streams and wetlands. General information is included about the distinguishing features that aid in identification of each order or class, and a wide variety of family illustrations and descriptions are also provided. However, in certain cases you should refer to more complete dichotomous key to determine the family.

The illustrations are courtesy of the University of Minnesota and are found in the [Guide to Aquatic Invertebrate of the Upper Midwest](#). The illustrations are drawn either in plan (dorsal) or side (lateral) views; except the water penny (the underside is illustrated). For additional resources visit: <https://go.wv.gov/sos>.

Note: This guide describes more than 60 different kinds of macroinvertebrates; however, not all possible families (kinds) are included.

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Size categories (mm)

Tolerance ratings

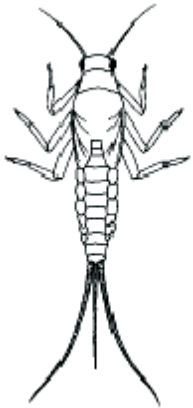
Very large (VL)	Large (L)	Medium (M)	Small (S)	Very small (VS)	Low (L)			Moderate (M)			High (H)			
> 50	50 - 30	29 - 15	14 - 5	< 5	1	2	3	4	5	6	7	8	9	10

- **Habitat preferences:** (F) Flowing (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)

Note: The order Hemiptera (True bugs) are not included. This group uses atmospheric oxygen, so they are not used to assess the biological conditions of wadeable streams and rivers. They become more important in the assessment of lake, wetland and large river environments.

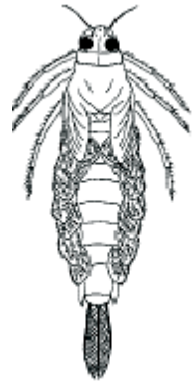
Cover photo courtesy of [Neil Gillies](http://www.cacaponinstitute.org/), Director of the Cacapon Institute (<http://www.cacaponinstitute.org/>)

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 (tail) filaments usually occur at the end of the abdomen, but there may only be two in some kinds.



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)



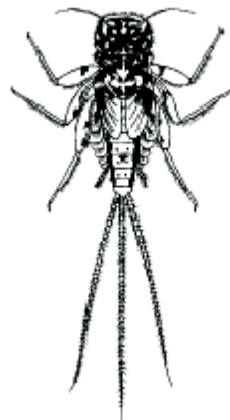
Siphonuridae (Primitive minnow mayfly)

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)



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)



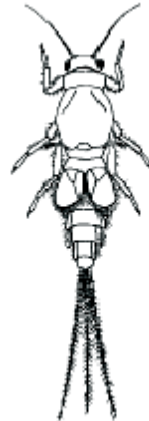
Heptageniidae (Flatheaded mayfly)

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)



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)



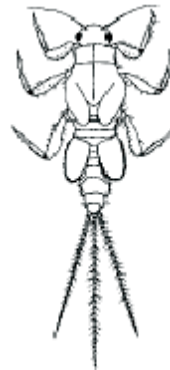
Caenidae (Square-gilled mayfly)

Gills on the first abdominal segment very small; gills on the second segment operculate (plate-like) covering much of the remaining gills. Crawler, burrower; Collector, gatherer; (M); VS-S (F/S)



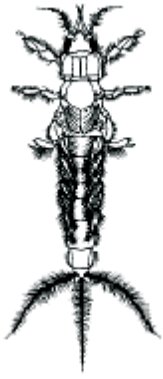
Leptophlebiidae (Prong-gilled mayfly)

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)



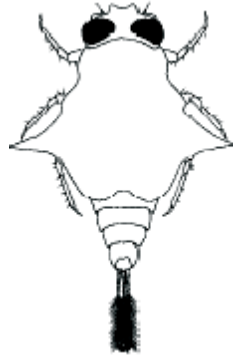
Tricorythidae (Stout-crawler mayfly)

Gills absent from abdominal segment one; gills on segment two are covered (operculate), plate-like triangular or oval shaped and conceals gills on segments three through six. This family is similar in appearance to Caenidae. Crawler, burrower; Collector, gatherer; (M); VS-M (F/S)



Ephemeridae (Burrowing mayfly)

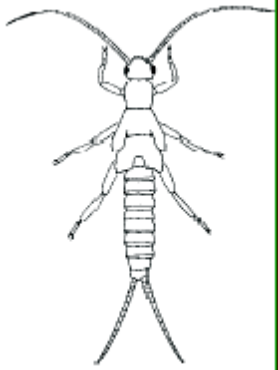
Has upturned mandibular tusks; head and front legs slightly widened and are used for burrowing; gills on the upper abdominal segments are small and the remaining gills are forked with fringed margins (feathered) and held over the top and sides of the abdomen. Burrower; Collector, gatherer; (M); M-L (S/F)



Beatiscidae (Armored mayfly)

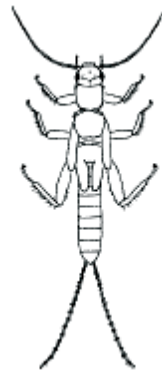
Top portion of the thorax is fused and covers most of the abdomen concealing the gills; caudal filaments are short and fringed with hairs. Burrower, crawler; Collector, gatherer; (M); VS-M (F)

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.



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)



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 in appearance to Capniidae. Clinger, crawler; Shredder; (L); S-M (F)



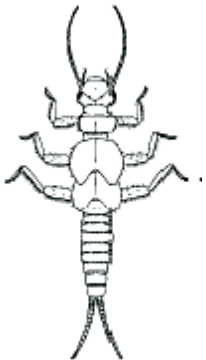
Taeniopterygidae (Large winter stonefly)

Stout bodies with pronotum much wider than the abdomen; wing pads greatly divergent from the midline. Clinger, crawler; Shredder, scraper; (L); S-M (F)



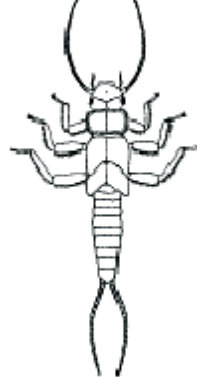
Perlidae (Golden stonefly)

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. Sometimes called the golden stonefly. Clinger, crawler; Predator; (L); M-L (F)



Chloroperlidae (Green stonefly)

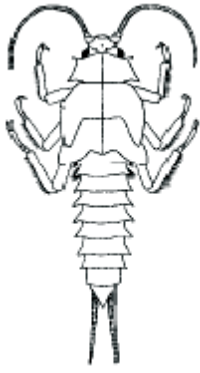
Body elongated, front of the thorax slightly wider than the abdomen; wing pads not divergent from the midline; tails (cerci) shorter than the abdomen. Will sometimes have patterns similar to Perlodidae. Clinger, crawler; Predator; (L); M (F)



Perlodidae (Patterned stonefly)

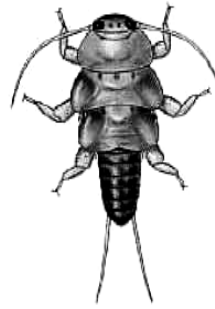
Strikingly patterned and colored similar in appearance to Perlidae; hind wing pads divergent; no gills on the thoracic segments. Clinger, crawler; Shredder; (L); M-L (F)

Note: The illustration does not show the pattern common to this family.



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)



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)

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 (also called cases or nets) consisting of a wide variety of materials collected from the streambed.



Hydropsychidae (Common net-spinning caddisfly)

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. Clinger, crawler; Collector, filterer; (M); M-L (F/S)



Philopotamidae (Finger-net caddisfly)

Labrum (structure between the mouthparts) is t-shaped and membranous; head capsule large usually orange in color; 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)



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; (M); S-L (F/S)



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; referred to by trout fishers as the green sedge. 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)



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)



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)



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)

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)



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)



Uenoidae (Uenoid-case caddisfly)

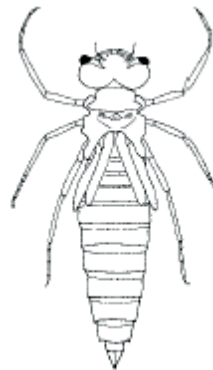
The first two thoracic segments are hardened and there are some small plates present on the third; abdominal segment one has a hump, and the anterior margin of their mesonotum is notched on either side of the midline; cases are variable but usually always constructed with small stones and sand. Clinger, crawler; Scraper; (L); S-M (F)

Order **Odonata** (**Dragonflies** and **Damselflies**): 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.



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)



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)



Calopterygidae (Broad-wing damselfly)

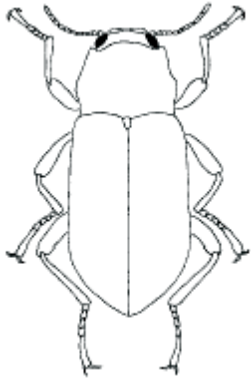
Lower portion of labium is diamond shaped; first antennal segment longer than all the others together; middle gills shorter than the lateral two; no visible veins on the gills. Clinger, crawler; Predator; (M); M-L (S/F)



Coenagrionidae (Narrow-wing 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)

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 of the insect groups, but are not as common in aquatic environments.



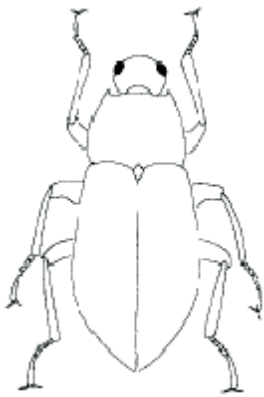
Elmidae (Riffle beetle adult)

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)**



Elmidae (Riffle beetle larva)

Legs with four segments and a single claw; nine abdominal segments some with a cavity that protect the hind gills. Clinger, crawler; Scraper, shredder; **(M)**; VS-S **(F)**



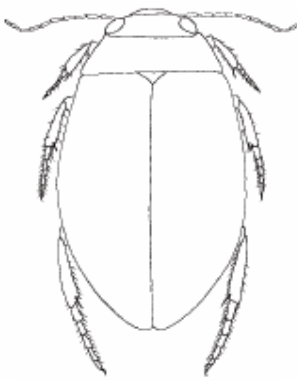
Dryopidae (Long-toed beetle)

Adults are hard bodied with very short comb-like antennae. The family is similar in appearance to the adult riffle beetle. The larva of this beetle is not aquatic but may be found in the splash zone. Clinger, crawler; Shredder; **(M)**; VS-S **(F/S)**



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)**



Dytiscidae (Predacious diving beetle adult)

Legs have five-segments and two-claws on the end; abdomen terminates into a pair of filaments. Swimmer, crawler; Predator; **(M)**; VS-VL **(S)**



Dytiscidae (Predacious diving beetle larva)

Slender antennae; hind coxae extends posterior dividing the first abdominal segment into two sections. Swimmer, crawler; Predator; **(M)**; VS-VL **(S)**



Gyrinidae (Whirligig beetle adult)

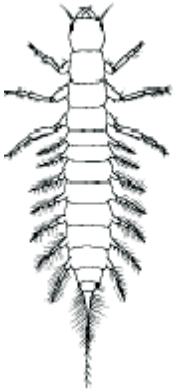
Compound eyes, which appear divided into pairs; antennae clubbed; mid and hind legs paddle-like. Swimmer, crawler; Predator; **(M)**; S-L **(S/F)**



Gyrinidae (Whirligig beetle larva)

Two claws of each leg, legs with five segments; ten abdominal segments with pairs of lateral filaments. Swimmer, crawler; Predator; **(M)**; S-L **(S/F)**

Order Megaloptera (Hellgrammites and Alderflies): 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.



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)



Corydalidae (Hellgrammite/Fishfly)

Elongate dorsally flattened body; large jaws on the head, projecting forward; first eight abdominal segments and segment ten with paired lateral filaments; abdomen terminates in fleshy appendages bearing hooks. Clinger, crawler; Predator; (L); M-VL (F)

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.



Chironomidae (Non-biting midge)

Hardened clearly visible head; long worm-like body; two pairs of prolegs with terminal hooks. Some families may be red in color due to a hemoglobin-like compound. Crawler, burrower; Collector, gatherer; (H); VS-L (F/S)



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)



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)



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)



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)



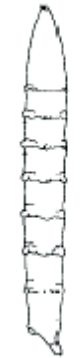
Empididae (Dance fly)

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)



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)



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)



Class Collembola (Springtails)

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

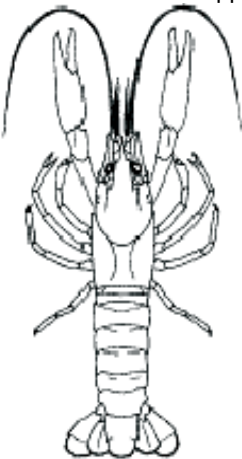


Hydrachnidae (Water mites)

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/S)

Non-insect groups

Sub-phyllum **Crustacea** (Crayfish, Scuds, Sowbugs and Shrimp): 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.



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)



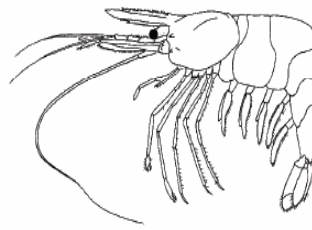
Gammaridae (Sideswimmer/Scud)

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/S)



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)



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, collector; (M); M-VL (S)

Class **Gastropoda** (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 (dextral) 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. For more information and images, visit Marshall University's [Aquatic Snails of West Virginia](#) website.



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)



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)



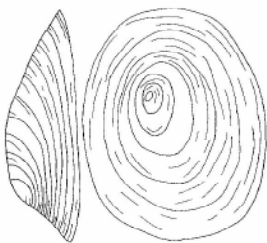
Planorbidae (Orb snail)

Shell is coiled flat instead of extended in a spiral; no operculum. Clinger, burrower; Scraper; (M) (S/F)



Physidae (Left-handed snail)

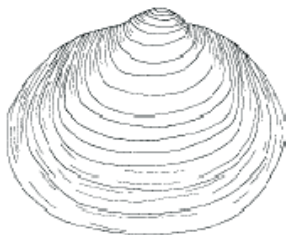
Shell is high, spiraled, with a slight bulge; opens to the left when the narrow end is held up; no operculum. Clinger, crawler; Scraper; (H) (S/F)



Ancyliidae (Limpet)

Shell shaped like a low flat cone; no operculum. Clinger, burrower; Scraper; (H) (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.



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)



Corbiculidae (Asian clam)

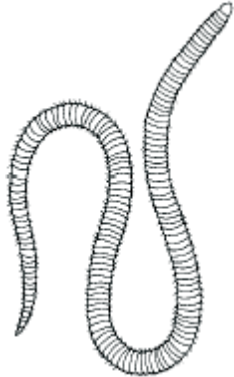
Shell is rounded; brown in color usually lighter than mussels; raised separated ridges along the top and sides of the shell. Clinger, burrower; Collector, filterer; (M); VS-VL (S/F)



Unionidae (Mussel)

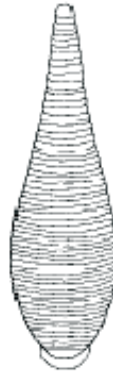
Largest of the bivalves; shell usually dark in color, variable in shape but maybe somewhat oblong; has many indentations and ridges on the tops and sides of the shell. Clinger, burrower; Collector, filterer; (L); VS-VL (S/F)

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.



Class Oligochaeta (Aquatic worms)

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 (S/F)



Class 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)



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. Collector, gatherer; (H); VS-L (S/F)

Note: Not a member of the phylum Annelida

Functional feeding groups are 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 materials; shredders, which consume leaf litter or other CPOM, including wood; collectors and 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 and piercers. It is important to keep in mind that many kinds of invertebrates use a variety of food acquisition methods. The general categories are provided here.

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.

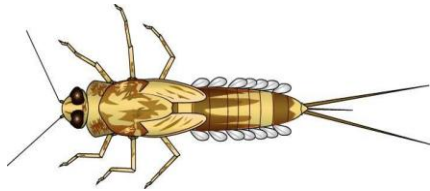
1. **Abdomen:** The third main division of the body; behind the head and thorax.
2. **Anterior:** In front (before).
3. **Apical:** Near or pertaining to the end of any structure, part of the structure that is farthest from the body.
4. **Basal:** Pertaining to the end of any structure that is nearest to the body.
5. **Burrower:** Animal that uses a variety of structures designed for moving and burrowing into sand and silt, or building tubes within loose substrate.
6. **Carapace:** The hardened part of some arthropods that spreads like a shield over several segments of the head and thorax.
7. **Caudal filament:** Threadlike projection at the end of the abdomen, like a tail.
8. **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.
9. **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.
10. **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.
11. **Detritus:** Disintegrated or broken up mineral or organic material.
12. **Dextral:** The curvature of a gastropod shell where the opening is visible on the right when the spire is pointed up.
13. **Distal:** Near or toward the free end of any appendage; that part farthest from the body.
14. **Dorsal:** Pertaining to, or situated on the back or top, especially of the thorax and abdomen.
15. **Elytra:** Hardened shell-like mesothoracic wings of adult beetles (Coleoptera).
16. **Femur:** The leg section between the tibia and coxa of Arthropoda, comparable to an upper arm or thigh.
17. **Flagellum:** A small fingerlike or whip-like projection.
18. **Gill:** Any structure especially adapted for the exchange of dissolved gases between animal and a surrounding liquid.
19. **Glossae:** A lobe or lobes front and center on the labium; in Plecoptera, the lobes are between the paraglossae.
20. **Hemimetabolism:** incomplete metamorphosis.
21. **Holometabolism:** complete metamorphosis.
22. **Labium:** Lower mouthpart of an arthropod, like a jaw or lip.
23. **Labrum:** Upper mouthpart of an arthropod consisting of a single usually hinged plate above the mandibles.
24. **Lateral:** Feature or marking located on the side of a body or other structure.
25. **Ligula:** Forming the ventral wall of an arthropod's oral cavity.
26. **Lobe:** A rounded projection or protuberance.
27. **Mandibles:** The first pair of jaws in insects.
28. **Maxillae:** The second pair of jaws in insects.
29. **Multi spiral:** A growth pattern on the opercula of some gastropods marked by several turns from the center to the edge.
30. **Operculum:** A lid or covering structure, like a door to an opening.
31. **Palpal lobes:** The grasping pinchers at the end of the Odonata lower jaw.
32. **Pauci-spiral:** A growth pattern on the opercula of some gastropods marked by few turns from the center to the edge.
33. **Periphyton:** Algae and associated organisms that live attached to underwater surfaces.
34. **Posterior:** Behind; opposite of anterior.
35. **Proleg:** Any projection appendage that serves for support locomotion or attachment.
36. **Prothorax:** The first thoracic segment closest to the head.
37. **Rostrum:** A beak or beak-like mouthpart.
38. **Sclerite:** A hardened area of an insect body wall, usually surrounded by softer membranes.
39. **Seta** (pl. setae): Hair like projection.
40. **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

1. B.K. Jessup, A. Markowitz and J.B. Stribling. 2002. [Family-Level Key to Stream Invertebrates of Maryland and Surrounding Areas](#). Tetra Tech, Inc.
 2. Bouchard, R.W. 2004. [Guide to Aquatic Invertebrates of the Upper Midwest](#): Identification Manual for Students, Citizen Scientist's and Professionals. University of Minnesota
 3. BVWM Biology Web - [Using aquatic invertebrates to determine water quality](#)
 4. Cacapon Institute's eSchool – [The benthic portal](#)
 5. Creek Connections – [Aquatic Invertebrate Fact sheets](#). Allegheny College, PA
 6. Introduction to aquatic invertebrate monitoring ([Riverwatch](#))
 7. Izaak Walton League of America. 2000. [Field Guide to Aquatic Macroinvertebrates](#). McDonald and Woodward Publishing Company
 8. J. Adams, M. Vaughan and S.H Black. 2004. [The Xerces Society's CD-ROM: Stream Bugs as Biomonitors](#). Xerces Society.
 9. J. Reese Voshell, Jr. 2002. [A Guide to Common Freshwater Invertebrates of North America](#). McDonald and Woodward Publishing Company
 10. McCafferty, W.P. 1981. [Aquatic Entomology: The Fisherman's and Ecologist's Guide to Insects and their Relatives](#). Jones and Bartlett Publishers
 11. R.W. Merritt and K.W. Cummins. 1996. [An Introduction to the Aquatic Insects of North America](#) 3rd Edition. Kendall/Hunt Publishing Company
 12. Stroud Water Research Center's – [Macroinvertebrate images and dichotomous key](#)
 13. University of Alberta, Department of Biological Sciences. 2007. [Aquatic Invertebrates of Alberta Online Textbook](#)
 14. Valley City State University. [Digital Key to Freshwater Invertebrates of North Dakota](#)
 15. Wilkes University Center for Environmental Quality – [Macroinvertebrate metrics](#)
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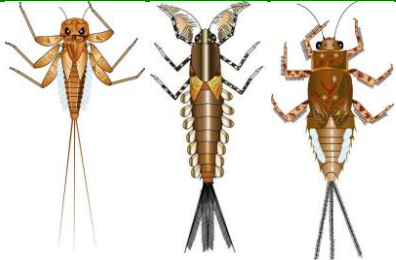


Small minnow mayfly *Baetidae*

What is an insect?

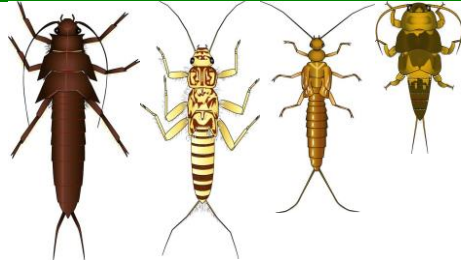
An insect is an invertebrate (an animal with no spine) that has three-pairs of legs (except Diptera) and three body divisions; the head is the location of the mouth, antenna, and eyes; the thorax is the attachment site for the legs and wing pads; and the abdomen, which often has a variety of structures attached including filaments gills and tails. Gills are usually leaf-like, plate-like, or thin filaments. Tails can be long and thin, hairy, webbed or paddle-like. Aquatic insects are described and illustrated on page one and the top of page two; non-insect group descriptions and illustrations begin on page two. Additional **tips** are provided at the bottom of page two.

Insect groups



Mayflies

Order **Ephemeroptera**: Three-pairs of legs with a single hook at the end; three some-times two tail filaments; gills attached to the abdomen, which may sometimes be covered and difficult to see. Mayflies exhibit several types of movements (or habits); swimmers, clingers, crawlers, and burrowers. (VS-M) (M) Families above left-right: *Heptageniidae*, *Isonychiidae* and *Ephemerellidae*.



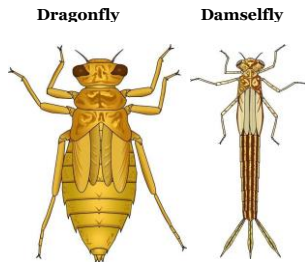
Stoneflies

Order **Plecoptera**: Three-pairs of legs with two-hooks at the end; two tail filaments; no gills attached to the abdomen but some kinds may have gills near the top of the abdomen; gills if visible, mostly on the legs and thorax. (S-VL) (M) Families above left-right: *Pteronarcyidae*, *Perlidae*, *Capniidae* and *Peltoperlidae*.



Case-building caddisflies

Order **Trichoptera**: Grub-like soft body and a hard head; Three-pairs of legs located on the upper third of the body; tail is small and usually forked, sometimes fringed with hairs; 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. (VS-L) (M) Families above left-right: *Brachycentridae*, *Limnephilidae* and *Glossosomatidae*.



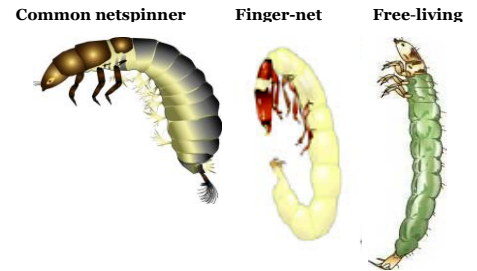
Dragonflies and Damselflies

Order **Odonata**: Three-pairs of legs; large eyes; long spoon-like jaws; no tails on the abdomen. **Dragonflies** sub-order *Anisoptera* have a broad shaped abdomen, while the **Damselflies** sub-order *Zygoptera* abdomen's is much narrower. Damselflies gills are attached to the end of the abdomen, they look like tails. (M-VL) (M)



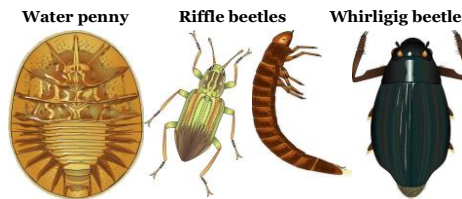
Fishflies and Alderflies

Order **Megaloptera**: Three-pairs of legs; large pinching jaws; eight-pairs of filaments attached to the sides of the abdomen. **Fishflies** family *Corydalidae*, have a two-hooked tail, whereas **Alderflies** family *Sialidae* have a single tapered tail and are usually much smaller and lighter in color. (M-VL)



Net-spinning caddisflies

Order **Trichoptera**: Similar characteristics as above but the abdomen usually has more abundant gills, especially the Common net-spinning caddisfly. 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. (S-L) (M) Families above left-right: *Hydropsychidae*, *Philopotamidae* and *Rhyacophilidae*.



Beetles

Order **Coleoptera**: Three-pairs of legs; body usually covered by a hard exoskeleton. The **Water penny** family *Psephenidae* and **Riffle beetle** family *Elmidae* are common in rocky-bottom streams. Other adult/larvae beetles are occasionally collected. (VS-L) (M)

True flies

Order **Diptera**: Usually the body is segmented with some type of visible features either along the body, or at the head or tail regions (i.e. head, tails, prolegs, whelps etc.). **Note**: This order is the only aquatic insect without fully developed legs in the larval stages.

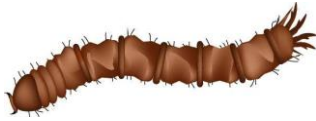
Dipterans are very diverse order with many aquatic varieties. Common kinds are described here.



Non-biting midge

Order **Diptera** family *Chironomidae*: Segmented body with a visible head; two leg-like projections at the front and rear. Sometimes they are bright red in color. (VS-M)

True flies continued.



Crane fly

Order **Diptera** family *Tipulidae*: No legs, no visible head; plump body with lobes along the segments; may have structures that look like tentacles, lobes or one bulb at the end of the body. (S-VL)



Black fly

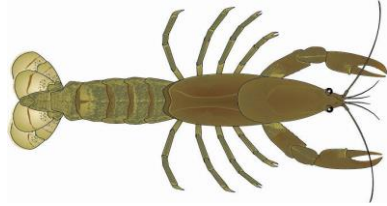
Order **Diptera** family *Simuliidae*: Body has a bowling-pen shape (lower is wider than the upper); there are multiple brushes/fans on the head and a ring of hooks on the abdomen. (VS-M)



Watersnipe fly

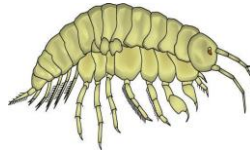
Order **Diptera** family *Athericidae*: Plump body, looks very much like a caterpillar; on the underside there are structures that look similar to legs but are not segmented; the tail is forked and fringed with hairs. (S-L)

Non-Insect groups



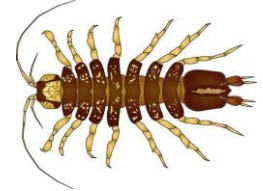
Crayfish

Class **Crustacea** order *Decapoda*: Five pairs of legs, the first two usually have large claws; large flipper-like structure at the end of the abdomen. (M-VL) (M)



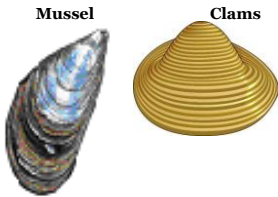
Scud/Sideswimmer

Class **Crustacea** order *Amphipoda*: Seven pairs of legs, the first two may be claw-like; body is somewhat higher than it is wide. Usually swims with a sideways motion. (S-M)



Aquatic sowbug

Class **Crustacea** order *Isopoda*: Seven pairs of legs, the first two may be claw-like; very long antenna; body is wider than it is high, giving the animal a fairly flattened appearance. (S-M)



Clams and Mussels

Class **Bivalvia**: Fleishy body enclosed between two-hinged shells; the shape and ridge spacing of the shells can determine different kinds. **Mussels** are usually larger than **Clams** and have dark colored oblong shells. (VS-VL) (M)



Operculate snails

Class **Gastropoda** sub-class *Prosobranchia*: Fleishy body enclosed by a single shell, which is usually coiled in an upward spiral. The opening of the shell is covered by an operculum (door). (VS-L) (M)



Non-operculate snails

Class **Gastropoda** sub-class *Pulmonata*: Fleishy body enclosed by a single shell, which is sometimes coiled upward but also may lie flat or have a conical shape. The opening of the shell is not covered by an operculum. (VS-L) (M)



Aquatic worms

Phylum **Annelida** class *Oligochaeta*: Body is long with numerous segments along its entire length; has no visible head or tail. (VS-VL)



Leeches

Phylum **Annelida** class *Hirudinea*: Body is long and thin or slightly widened; 34-segments along its length, but there appears to be many more. (S-VL)



Flatworms

Class **Turbellaria**: Soft elongate body without segment; head triangular shaped with eyes on top, which give the animal a cross-eyed appearance. (VS-L)

Learn more at: <https://go.wv.gov/sos>

Sizes illustrated not proportional.



Identification of benthic macroinvertebrates (BMIs) is easier when viewed in the same orientation as the illustrations. Most illustrations are drawn in top and side views; the water penny is shown in underside view. Use **morphological** features as your basis for identification; the size and color are often variable and influenced by environmental factors. The (M) indicates that multiple kinds may be collected from within the order or class.

Size categories (size range in mm): > 50 Very large (VL); 50 - 30 Large (L); 29 -10 Medium (M); 10 - 5 Small (S); < 5 Very small (VS)

Note: This field guide will help you identify common aquatic invertebrate classes, orders, and a few families. You should always use to a more complete guide for verification and family level identification. With practice, you will be able to identify a wide variety of families in the field.