

STREAM HEALTH LESSON PLAN

For Instructor Use Only



PRICKLY PEAR
LAND TRUST

STREAM HEALTH

Location: Ten Mile Creek Park

Aim: Introduction to what makes a healthy stream, riparian zone, and floodplain, and macroinvertebrates

Time: Maximum 2 hours

Common Core State Standards: LS2.C, LS1.A

Next Generation Science Standards:

HS-LS2-2, HS-LS2-6, HS-ESS2-2, HS-ESS2-5

Guiding Questions:

What does a healthy riparian zone look like?

Do you think there are specific adaptations plants and animals may have developed to thrive here? What are they?

Why are riparian zones so important, particularly in areas like Montana?

Learning Objectives:

Define what a riparian zone is

Understand the importance of riparian zones

Explain why flooding, which is often seen as a bad thing, is important to floodplain ecosystems

Discuss some factors and indicators of a healthy stream

Lesson Timeline

Note: Most of this lesson will be spent doing macroinvertebrate sampling and does not require a lot of presenting.

Students arrive, greet them and introduce yourself

**10
MIN**

Try to be as engaging as possible. The introduction with the students is what sets the tone for the rest of the lesson. This does not require you to have any special skills, just be friendly and be yourself. It would be great if you included some information about what you do, or did, for work. It is a good opportunity to introduce the students to different careers and does not need to be related to the lesson you are leading.

Ask the students to introduce themselves. Up to you how you want to do this.

**5
MIN**

Ask the students if they know what a riparian zone is. Ask if they can figure out what is an important event for floodplain ecosystems (hint: it's flooding events)

Give a short introduction to riparian zones.

**30-40
MIN**

What is a riparian zone
What makes a healthy riparian zone
Ask students if they can imagine how root systems contribute to riparian corridors.
Discuss the structural integrity they bring to a river.
Why flooding is important
Why riparian zones are vital to both terrestrial and aquatic species even though they cover relatively small areas
The groupings for macroinvertebrates. Give a couple examples of macroinvertebrates that can be found in health streams.

**1-1.5
HRS**

The rest of the lesson will be spent collecting and identifying macroinvertebrates. The instructions for sampling and the identification key are included here, worksheets and materials can be picked up with the physical lesson plan at the Prickly Pear Land Trust Office.

Background Info

Introduction

Riparian zones are the transitional areas adjacent to streams, rivers, lakes, and wetlands. Healthy riparian zones are rich in biodiversity and play an important role in protecting water quality and stream ecosystem health. They can be identified by the dense areas of vegetation that line the banks of bodies of water. The soil in a riparian area consists of layered sediments of varying textures and sizes that are subject to intermittent flooding and fluctuating water tables. The amount of time that soils remain moist depends on the water levels of the adjacent body of water. This makes a big difference to riparian plants and determines where plants can grow. Healthy riparian zones that contain a variety of native woody and herbaceous plant species provide habitat and food for aquatic organisms as well as terrestrial animals. Root structure in a healthy, dense mix of riparian vegetation strengthens streambanks, which helps control erosion caused by fast moving streams and flooding. The riparian vegetation also helps to slow the speed of runoff water, which allows nutrients and sediments to drop out of the water. The nutrients are taken up by the plants and then released when the plants die or decompose.

Riparian vegetation functions as a sponge that reduces surface flow during rain and flood events, and absorbs pollutants in storm water runoff. Soil microbes that thrive in these moist environments break down chemical pollutants like hydrocarbons, further protecting water quality. In addition, tree canopies in riparian zones provide shade, which helps maintain cooler water temperatures. This allows for higher dissolved oxygen levels, which is necessary for healthy streams that support diverse aquatic life. These ecosystems are extremely productive and support most terrestrial wildlife in arid (dry) environments.

The fine-textured sediments in floodplains are also able to hold large amounts of water. Water stored in these soils provides base flow (groundwater seepage) to sustain water in creeks and rivers during dry months. Many plant species rely on small-scale flood events to survive and get access to water. When a stream floods, it brings much needed water to the plants on the floodplain. The water also carries nutrients and soil with it, and deposits them on the floodplain, which is what makes them productive agricultural areas.

Flora & Fauna

Montana's riparian and wetland communities support the greatest concentration of plants and animals in Montana, but the types of communities vary widely depending on the region and elevation. While they cover only 4% of Montana, because the state is so dry (#45 in average rainfall), these riparian corridors are critical sources of water for flora and fauna. They support both local plants and animals, as well as migratory species that need places to stop for water, food, and shelter. There are a total of 265 terrestrial vertebrate species that are found within riparian and wetland communities, 196 of which are essentially associated. Essentially associated species rely on riparian and wetland habitats for breeding, food, and/or habitat. There are 19 species of greatest concern (species that are at risk due to declining populations, loss of habitat, and/or other factors) associated with Montana's riparian and wetland habitats. These species are listed below.

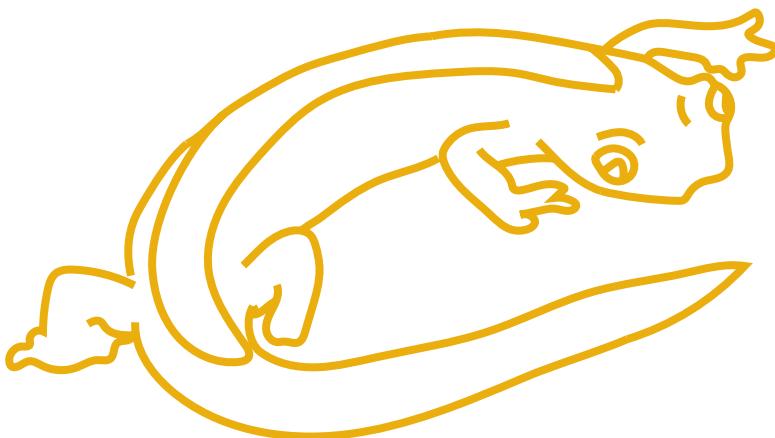
Species of Greatest Concern

Amphibians: Coeur d' Alene Salamander, Western Toad, and Northern Leopard Frog

Reptiles: Snapping Turtle, Spiny Softshell, and Western Hog-nosed Snake

Birds: Common Loon, Trumpeter Swan, Harlequin Duck, Bald Eagle, Yellow Rail, Piping Plover, Interior Least Tern, Black Tern, Sedge Wren, and Nelson's Sharp-tailed Sparrow

Mammals: Townsend's Big-eared Bat, Northern Bog Lemming, and Meadow Jumping Mouse



Flora

Alder (*Alnus spp.*)
Aspen (*Populus tremuloides*)
Baltic Rush (*Juncus balticus*)
Birch (*Betula spp.*)
Black Cottonwood (*Populus trichocarpa*)
Black Hawthorn (*Crataegus douglasii*)
Bluejoint Reedgrass (*Calamagrostis canadensis*)
Bog Birch (*Betula glandulosa*)
Bog Sedge (*Carex rostrata*)
Bur Oak (*Quercus macrocarpa*)
Cattails (*Typha spp.*)
Choke Cherry (*Prunus virginiana*)
Cinquefoil (*Potentilla spp.*)
Currant (*Ribes spp.*)
Douglas-fir (*Pseudotsuga menziesii*)
Engelmann Spruce (*Picea engelmannii*)
Grand Fir (*Abies grandis*)
Grand Fir (*Abies grandis*)
Green Ash (*Fraxinus pennsylvanica*)
Lake Sedge (*Carex lacustris*)
Maritime Sedge (*Carex incurviformis*)
Northern Reedgrass (*Calamagrostis inexpansa*)
Plains Cottonwood (*Populus deltoides*)
Red-osier Dogwood (*Cornus stolonifera*)
Rose (*Rosa spp.*)
Rushes (*Juncus spp.*)
Saxifrage (*Saxifraga spp.*)
Sedges (*Carex spp.*)
Shrubby Cinquefoil (*Potentilla fruticosa*)
Silver Sage (*Artemisia cana*)
Snowberry (*Symphoricarpos spp.*)
Subalpine Fir (*Abies lasiocarpa*)
Thimbleberry (*Rubus parviflorum*)
Tufted Hairgrass (*Deschampsia cespitosa*)
Twin-berry (*Lonicera involucrata*)
Utah Honeysuckle (*Lonicera spp.*)
Water Birch (*Betula occidentalis*)
Western Hemlock (*Tsuga heterophylla*)
Western Larch (*Larix occidentalis*)
Western Red Cedar (*Thuja plicata*)
Willows (*Salix spp.*)



Macroinvertebrates

The presence of gill breathing macroinvertebrates, such as mayflies, stoneflies, and caddisflies, as well as gill or water breathing snails, often indicate healthy streams. When sampling macroinvertebrates, the biggest indicator of stream health is diversity. The more species you see, generally, the healthier the stream is. In addition, macroinvertebrates are generally divided into categories. Group 1 species are highly sensitive species that need their stream to have high dissolved oxygen, a neutral pH, and cold water. Group 2 species are somewhat pollution tolerant. Dependent on the species, they can tolerate some pollution, warmer waters, less dissolved oxygen and a greater range of pH. Group 3 species are very tolerant, they can survive with higher levels of pollution, warm water, low dissolved oxygen, and high/low pH. The more species in Group 1 you find in a stream, the better your chances are that the stream is healthy.



Sampling Activity

Rocky Bottom Stream Sampling Instructions

Materials: 2 Kick or d-ring nets
2 Collection buckets
1 Light colored plastic tarp
20 Magnifying glasses
20 Identification keys

Location: Ten Mile Creek Park, near picnic tables and stream entry

Instructions: Insert the poles into the side-pockets of your kick-net.

Choose a site in the stream where a shallow riffle occurs (an area where water is flowing over rocks creating a light churning effect in the water). You want a fast-moving area of water with a depth of 3 to 12 inches and cobble-sized stones (2 to 10 inches) or larger

Enter downstream of the study site and approach it by walking upstream so that you don't disturb the study area before the net is in place.

Insert the net into the water vertically, standing behind it (downstream), then tip the net downstream so that it is at a 45° angle to the water (see picture). Unlike the picture though, have two students hold the net. Don't allow the top of the net to dip below the surface of the water. *Note, if water is flowing over the top of the net, the water level is too high for safe monitoring.*



Continued

Place several medium-sized rocks on the bottom of the net to hold it down and prevent organisms from flowing under it.

Sample the streambed for a distance of three feet upstream of the kick-seine and across the width of the net.

Lift any rocks in the collection area and firmly and thoroughly rub your hands over all surfaces to dislodge any attached insects for 40 seconds.

After you have rubbed off any macroinvertebrates, carefully place each large rock outside of your three-foot sampling area.

Stir up the bed with your hands and feet until the entire area has been searched. All exposed and detached organisms will be carried into the net.

Then, for 20 seconds, use the toe of your shoe to jab the streambed with a shuffling motion, moving towards the net. Disturb the first few inches of sediment to dislodge burrowing organisms. Before removing the net, rub any rocks that you used to anchor the net to the stream bottom and remove the rocks from the bottom.

Firmly grab the bottom of the net so that your sample does not fall from the net, and then remove it from the water with a forward-scooping motion. The idea is to remove the net without allowing any insects to be washed under or off it.

Place the net on a flat area (picnic tables at 10 Mile are a good spot), out of direct sunlight if possible.

Use a watering can or spray bottle to periodically water your net. The organisms will stop moving as the net dries out. Occasionally wetting the net will cause the organisms to move, making them easier to spot if you missed any.

Using tweezers or your fingers, separate all the organisms from the mud and sticks and begin sorting them into ice cube trays.

Sort organisms into similar groups as you separate your sample. This will make your identification quicker when you are ready to record results. *For example, put all organisms with legs in one section and all organisms with no legs in another section.*

Any organism that moves, even if it looks like a worm, is part of the sample. Look closely, since most aquatic macroinvertebrates are only a fraction of an inch long. Be especially careful to look for caddisfly larvae, they often build themselves a "home" out of twigs, bark and pebbles and if you don't look carefully they look like sticks.

**DICHOTOMOUS KEY
TO STREAM MACROINVERTEBRATES**

(Page 1)

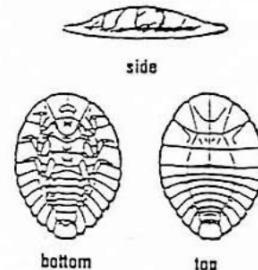
Drawings in this key are from: Merrit-Cummins: *An Introduction to the Aquatic Insects of North America*, Copyright 1977 by Kendall/Hunt Publishing Company; Izaak Walton League of America (IWL); or McCafferty: *Aquatic Entomology*, © 1981 Boston: Jones and Bartlett Publishers. Reprinted with permission.

1. A. Segmented legs.....go to 2
B. No segmented legs.....go to 14
2. A. 6 legs.....go to 3
B. More than 6 legs.....go to 23
3. A. No wings, or wings not fully developed and do not cover entire body.....go to 4
B. Wings cover entire body (but not legs), may appear beetle-like.....go to 26
4. A. Body longer than it is wide.....go to 5
B. Body oval & flat; head & legs concealed beneath body.....WATER PENNY
(a type of beetle larva)

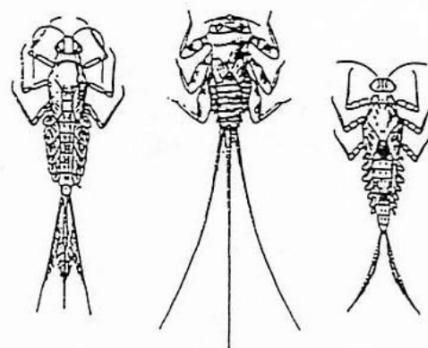
Order Coleoptera, Family Psephenidae
Feeding Group: SCRAPER

5. A. 2 or 3 distinct *hairlike* tails; tails not fleshy or hooked, but may be fringed with hairs.....go to 6
B. Not as above.....go to 7
6. A. 2-3 tails; platelike or hairlike gills along sides of abdomen.....MAYFLY LARVA
Order Ephemeroptera
Feeding Group: VARIES*

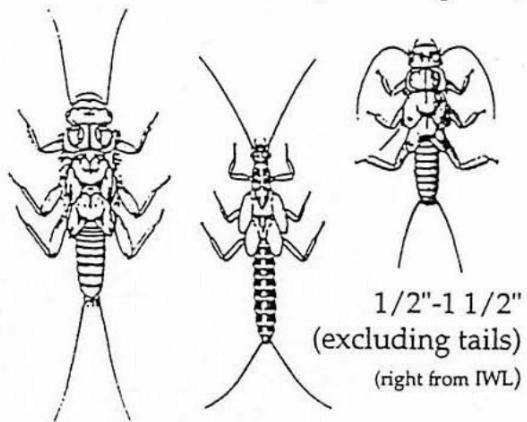
B. 2 tails; may have hairy gills under thorax.....STONEFLY LARVA
Order Plecoptera
Feeding Group: VARIES*



1/4"
(excluding tails)
(all from IWL)



(center from IWL) **1/4"-1"**
(excluding tails)



1/2"-1 1/2"
(excluding tails)
(right from IWL)

* If feeding group varies, see picture key on pages 155-157 for more information.
(All drawings on this page are from McCafferty: *Aquatic Entomology*, except as noted)

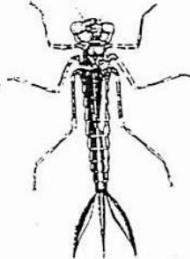
**DICHOTOMOUS KEY
TO STREAM MACROINVERTEBRATES**

7. A. 3 oar-shaped tails (gills) at *end* of abdomen; no gills along *sides* of abdomen

.....**DAMSELFLY LARVA**

Order Odonata, Suborder Zygoptera

Feeding Group: PREDATOR



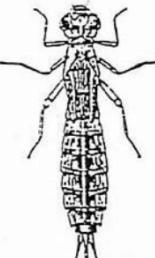
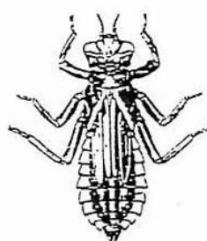
1/2"-1"
(left from IWL)

B. Not as above.....go to 8

8. A. Fat abdomen; large eyes; mask-like lower lip.....**DRAGONFLY LARVA**

Order Odonata, Suborder Anisoptera

Feeding Group: PREDATOR



1/2"-2"

B. Not as above.....go to 9

9. A. May be hiding in case made of gravel or plant parts; abdomen ends in pair of prolegs which may be hidden by hairs; each proleg has single hook on end, sometimes fused together

.....**CADDISFLY LARVA**

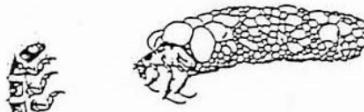
Order Trichoptera

Feeding Group: VARIES*



(IWL)

up to 1"



B. Not as above.....go to 10

10. A. Well developed lateral filaments extend from abdominal segments.....go to 11

- B. No lateral filaments along abdomen; body is hardened & stiff; tip of abdomen has small plate-like opening with hooks and filaments.

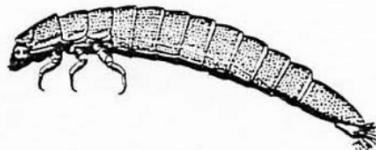
.....**RIFLE BEETLE LARVA**

Order Coleoptera, Family Elmidae

Feeding Group: GATHERER COLLECTOR



1/4"-1/2"



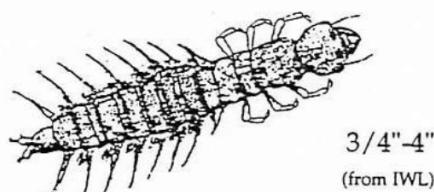
*If feeding group varies, see picture key on page 158-161 for more information
(all drawings on this page from McCafferty: *Aquatic Entomology*, except as noted)

**DICHOTOMOUS KEY
TO STREAM MACROINVERTEBRATES**

(Page 3)

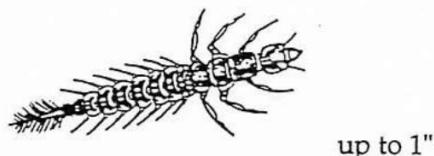
11. A. Fluffy or branched gill tufts under abdomen.....**DOBSONFLY LARVA**
 ("Hellgrammite")

Order Megaloptera, Family Corydalidae
 Feeding Group: PREDATOR



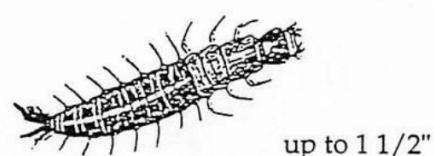
- B. Not as above.....go to 12

12. A. Abdomen ends in single, unforked, long, hairlike tail....**ALDERFLY LARVA**
Order Megaloptera, Family Sialidae
 Feeding Group: PREDATOR

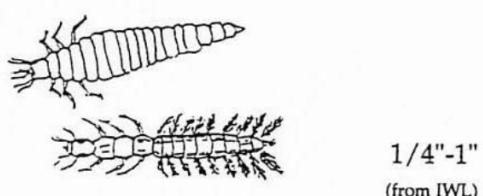


- B. Not as above.....go to 13

13. A. Abdomen ends in a pair of prolegs, each with 2 hooks.....**FISHFLY LARVA**
Order Megaloptera, Family Corydalidae
 Feeding Group: PREDATOR



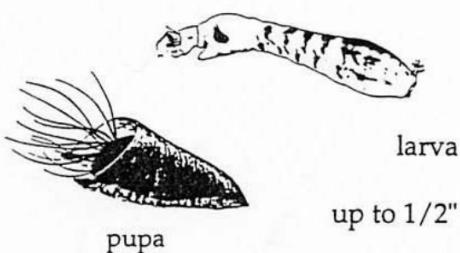
- B. Not as above; large, obvious mouthparts.....**AQUATIC BEETLE LARVA**
Order Coleoptera
 Feeding Group: PREDATOR



14. A. Has small but distinct head; body less than 1/2" long.....go to 15

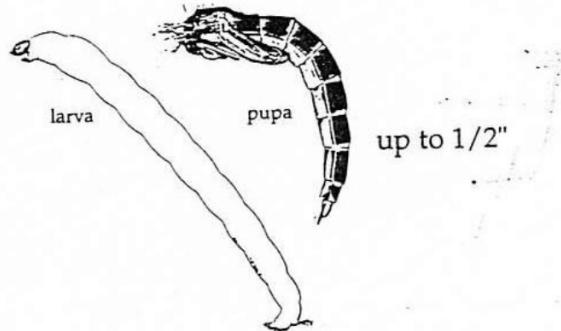
- B. Appears not to have a head, although it may be retracted into body.....go to 16

15. A. Body widens at bottom end (bowling pin shaped); may be attached to substrate; dark head....**BLACK FLY LARVA**
Order Diptera, Family Simuliidae
 Feeding Group: FILTERER COLLECTOR



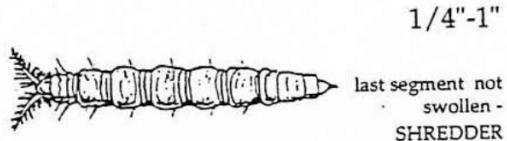
(all drawings on this page from McCafferty: *Aquatic Entomology*, unless otherwise noted)

15. B. Both ends of body about the same width; tiny pair of prolegs under head & at tip of abdomen.....**MIDGE LARVA**
Order Diptera, Family Chironomidae
 Feeding Group: GATHERER COLLECTOR



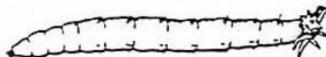
16. A. Fleshy Caterpillar-like body.....go to 17
 B. Body not caterpillar-like.....go to 18

17. A. Two feathered "horns" at back end; caterpillar-like legs
.....**WATERSNIPE FLY LARVA**
Order Diptera, Family Athericidae
 Feeding Group: PREDATOR

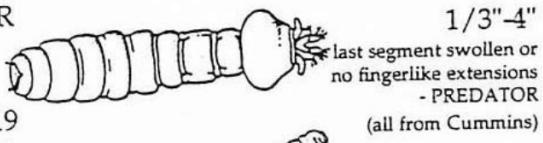


- B. Can be up to 4" long; head not apparent because it is retracted into body; may have fleshy, finger-like extensions at one end
.....**CRANEFLY LARVA**

- Order Diptera, Family Tipulidae**
 Feeding Group: SHREDDER OR PREDATOR



18. A. Body without hard shell.....go to 19
 B. Body with hard shell.....go to 21



19. A. Flattened, unsegmented, worm-like body; distinct eye spots; gliding movement.....**PLANARIAN**
 (Flatworm)

Class Turbellaria

Feeding Group: PREDATOR or PARASITE

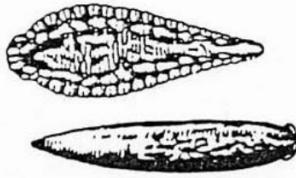


- B. Segmented body.....go to 20

up to 3/4"
 (from IWL)

20. A. Flattened body with suckers at each end.....**LEECH**

Class Hirudinea
 Feeding Group: PREDATOR or PARASITE



(all drawings on this page are from McCafferty: *Aquatic Entomology*, unless otherwise noted)

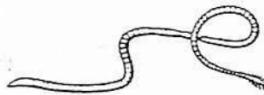
**DICHOTOMOUS KEY
TO STREAM MACROINVERTEBRATES**

(Page 5)

20. B. Segmented, earthworm-like body
.....**AQUATIC EARTHWORM**

Class Oligochaeta

Feeding Group: GATHERER COLLECTOR



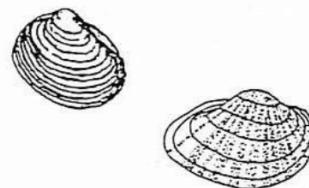
1/4"-2"

21. A. Snail-like.....go to 21

- B. Body enclosed within two hinged shells
.....**FRESHWATER CLAM or MUSSEL**

Class Pelecypoda

Feeding Group: FILTERER COLLECTOR



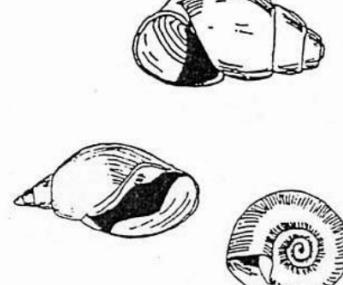
(both from IWL)

22. A. Has operculum (hard covering used to close the opening).....**GILLED SNAIL**
Class Gastropoda, Order Prosobranchia
Feeding Group: SCRAPER



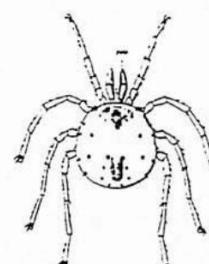
(right from IWL)

- B. No operculum; may be spiral-shaped, limpet-like, or coiled in one plane
.....**LUNG-BREATHING SNAIL**
Class Gastropoda, Order Pulmonata
Feeding Group: SCRAPER



(both from IWL)

23. A. Looks like spider; may be very tiny; has 8 legs.....**AQUATIC MITE**
Class Arachnida, Order Hydracarina
Feeding Group: PREDATOR



up to 1/8"

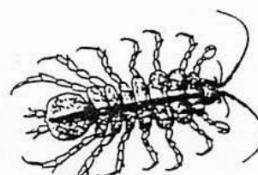
- B. Not as above.....go to 24

24. A. Lobster or shrimp-like.....go to 25

- B. Armadillo shaped body, wider than high; crawls slowly on bottom

-**AQUATIC SOWBUG**

Subphylum Crustacea, Order Isopoda
Feeding Group: SHREDDER



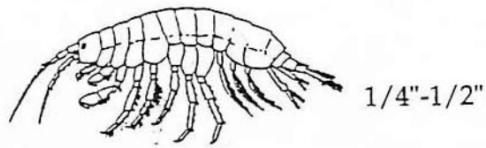
1/4"-3/4"

(all drawings on this page are from McCafferty: *Aquatic Entomology*, unless otherwise noted)

**DICHOTOMOUS KEY
TO STREAM MACROINVERTEBRATES**

(Page 6)

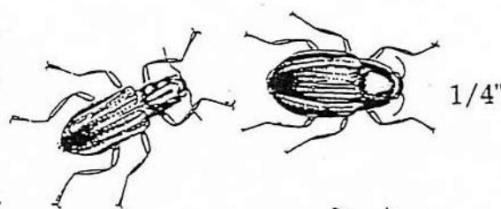
25. A. Looks like tiny shrimp; swims quickly on its side.....**SCUD**
Subphylum Crustacea, Order Amphipoda
Feeding Group: SHREDDER



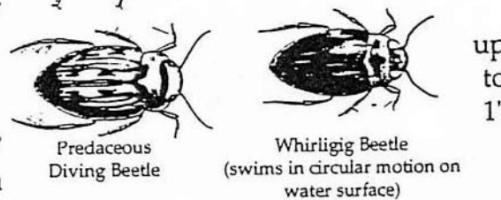
- B. Looks like small lobster; has 2 large front claws (10 legs total).....**CRAYFISH**
Subphylum Crustacea, Order Decapoda
Feeding Group: GATHERER COLLECTOR



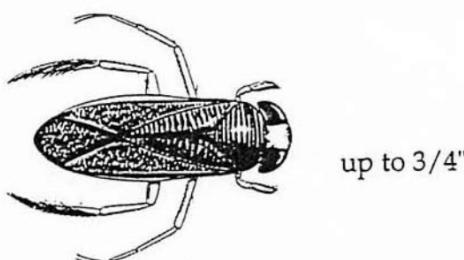
26. A. Beetle-like, crawls slowly on bottom.....**RIFFLE BEETLE ADULT**
Order Coleoptera, Family Elmidae
Feeding Group.: SCRAPER or GATHERER COLLECTOR



- B. Beetle-like, swims quickly.....go to 27
27. A. Wings meet along the midline of back side of body, they do not overlap.....**BEETLE ADULT**
Order Coleoptera
Feeding Group: MOST ARE PREDATORS



27. B. Wings overlap on backside, usually form a visible triangular pattern just below head.....go to 28



28. A. Front legs are shorter than mid and hind legs; propels itself with oar-like strokes,.....**WATER BOATMAN**
Order Hemiptera, Family Corixidae
Feeding Group: VARIES



- B. Similar to backswimmer but swims upside down, on its back.....**BACKSWIMMER**
Order Hemiptera, Family Notonectidae
Feeding Group: PREDATOR

(all drawings on this page are from McCafferty: *Aquatic Entomology*, unless otherwise noted)

Non-Classroom Activities

Mystery Macro Quiz

<https://dep.wv.gov/WWE/getinvolved/sos/Pages/MacroID.aspx><https://stroudcenter.org/news/mystery-macro-quiz/>

Caddisflies, Engineering an Ecosystem

<https://vimeo.com/273597362>

A Study in Stream Ecology

<https://vimeo.com/41021282>

HAPPY.

PRICKLY PEAR LAND TRUST HELENA MT

TRAILS.

PRICKLYPEARLT.ORG