MACROINVERTEBRATE STATION

Overview

An aquatic macroinvertebrate are small animals without backbones that spend at least a part of their lives in water. They include insects in their nymph and larval stages, snails, worms, crayfish, and clams. They are visible without the use of a microscope or magnifying glass. In this lesson students learn how to identify various types of aquatic macroinvertebrates in addition to understanding the ecological significance of these creatures in the riparian zone. Students will participate in collecting and observing live macroinvertebrate specimens. They will then count and record the types of macroinvertebrates that they find. Finally students will analyze the data that they collect in order to determine the health of the river they are observing. For the educator teaching this lesson, use the background information prior to the lesson plan to supplement your understanding and knowledge.

Time: 30 Minutes

Learning Goals: By the end of this station, students will be able to:

- Demonstrate basic macroinvertebrate identification
- Explain how macroinvertebrates are connected to salmon ecology
- Recall 1-2 types of invasive macroinvertebrates and describe how they are transported by humans.

Materials: The Macroinvertebrate Station Kit should include:

- D-frame nets or kicknets
- Large shallow pans for sorting
- Ice cube trays for specific sorting
- Hand lens or 2-Way Magnifying Viewer
- Forceps, brushes, turkey basters, eye droppers for picking up invertebrates
- Rubber knee boots
- WSC Salmon Food Web
- 1 Clipboard
- WSC Macroinvertebrate Guide
- Macroinvertebrate Dichotomous Key
- WSC Pollution Tolerance Group Key
- StreamWebs Macroinvertebrate Data Sheet (provided with equipment)
    - StreamWebs Macroinvertebrate Data Sheet - Spanish
- Guide to Pacific Northwest Aquatic Invertebrates Second Edition

Teaching Tips

Get students focused with brief introductions and safety instructions. Students and volunteers will need to be mindful of the rocky and slippery terrain by the river. If students go into the water, they should go in no deeper than their ankles and only to collect specimens.

Safety Protocols:

- Never let students go more than ankle deep in the water.
- Macroinvertebrate sampling should be conducted well away from and downstream from spawning salmon and redds.
- No more than four students in the river at a time.
- Avoid fast-moving water.
- Take care when walking on slippery rocks.
- Never drink the water—it could make you sick

In-river Collecting Techniques:

- One or two people hold net(s) downstream from the sample area, perpendicular to flow.
- One person begins disturbing (rubbing with hand or shuffling with boot) rocks, stocks or other leaf litter to remove any invertebrates. The invertebrates should flow into the net. Replace the rocks in the river.
- Keep an eye out for salmon redds or the area where salmon have laid their eggs.

  Redds are locations in the river that salmon and other fish use for spawning. Identify these areas by looking for 2 ft - 6 ft patches of rocks that have been stripped of their algae. These are sections that are "cleaner" than the surrounding river bottom, and they are usually located where there's a mix of fine gravel and larger cobble. If you spot a redd be sure to point it out to your students so they know what they are trying to avoid as they collect their specimens. There will be field experts and occasionally biologists participating in each workshop available to assist you to avoid redds

Background Information

What is a macroinvertebrate?

Macroinvertebrates are animals that lack a backbone ("invertebrate") and can be seen with the unaided eye ("macro"). These include insects such as immature and/or adult mayflies, stonefiles, caddisflies, true flies (e.g. mosquitoes), dragonflies and beetles, as well as other invertebrates such as snails, leeches, worms and mussels. Aquatic macroinvertebrates spend the majority of their time in lakes, rivers, and other aquatic environments.

Aquatic macroinvertebrates are affected by multiple different physical and chemical factors in both the river and the surrounding watershed. The structure and composition of the aquatic macroinvertebrate community tells an important story about the biological health of our rivers.

Macroinvertebrate and River Ecology

Macroinvertebrates are critically important in the aquatic food web. Some serve directly as food for predators such as fish, amphibians, birds, and other invertebrates; others help make more food or nutrients available in

the aquatic system by breaking down decaying animal and plant material. Fish populations like Pacific Salmon depend on healthy macroinvertebrate populations for food. The abundance and diversity of macroinvertebrates are determined by both the physical and biological condition of the river.

River Habitats

Illustration of the Riffle, Pool, and Run progressions of a river.

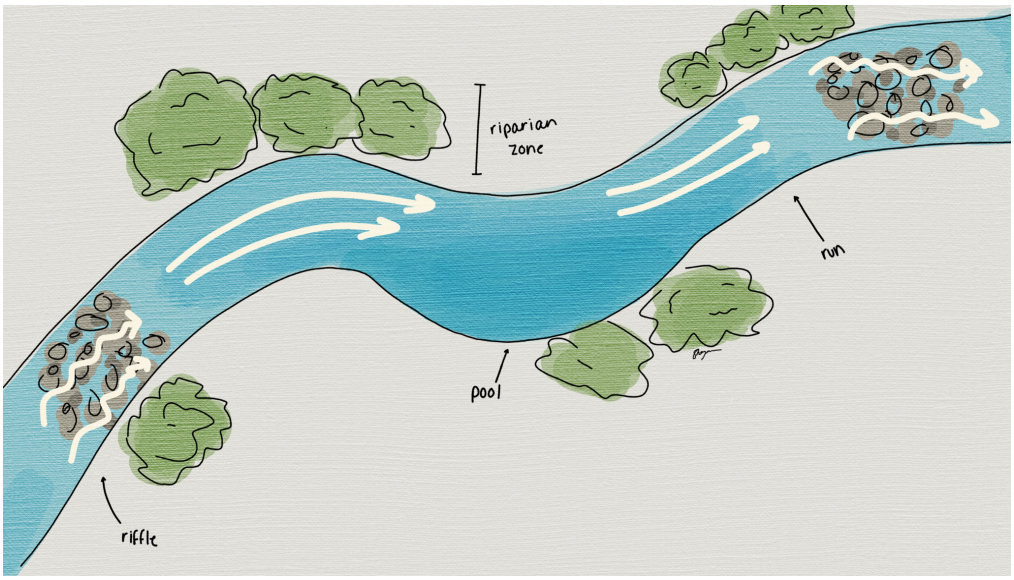


Illustration by Shayenna Nolan

Riffles

Are the sections of the river where water moves the fastest, is the shallowest, and where oxygen is abundantly mixed into the water. When you find yourself at a river where the water rushes over rocks, that is likely a riffle. Macroinvertebrates that prefer riffles include stoneflies, caddisflies, mayflies, and blackflies. These species are adapted to attach themselves to rocks and submerged plant matter in this fast moving water.

Pools

Pools are where fast flowing water begins to carve out the sediments at the bottom and sides, making the river wider and deeper. This slows the movement of water and carves out beautiful meandering s-shapes in the rivers. Macroinvertebrates that prefer slower flowing water include snails, aquatic worms, and crayfish.

Runs

Runs form when the deep water from pools has a uniform and fast flow. They occur after pools in rivers but before the shallow rocky riffles. This progression of riffles, pools, and runs is the natural progression of how water flows. You can even observe this yourself if you run water over a flat surface like a plate.

Functional Feeding Groups

Macroinvertebrates have a wide variety of shapes, sizes, appearances, and body parts, and these differences reflect a diversity of feeding habits as well. Macroinvertebrates feed on living material such as algae, plants, or other invertebrates and *detritus*. Detritus is dead or decomposing plants and animals. Macroinvertebrates are often classified according to the way in which they obtain their food. Macroinvertebrates can be classified by their *functional feeding groups (FFG)*: shredders, scrapers, collectors, predators. Observing the feeding habits of organisms can help us learn about their role in an ecosystem food web.

The main categories of functional feeding groups include:

Shredders

Chew on intact or large pieces (>1 mm) of plant material.
Usually found in leaf packs and water-logged wood in upriver riparian areas with high percentages of canopy cover. Examples: Giant Stoneflies, Northern Caddisflies

Scrapers

Scrape off and consume a thin layers of algae growing on solid substrates in shallower waters.
Found in mid-river open canopy areas that allow enough sunlight to support algal growth. Live under rocks.
Examples: snails, Flatheaded mayflies, water pennies

Collectors

Consume very small pieces of detritus (<1 mm)
Found in rocks and mud; common in all reaches, but make up a larger proportion in lower reaches where sediment collects. Examples: common netspinner caddisflies, back flies, brush-legged mayflies, mussels

Predators

Feed on living animals; may swallow smaller prey whole, tear pieces out of larger prey, or suck out body fluids.
Found in all habitat types, in smaller proportions relative to other feeding groups.
Examples: predaceous diving beetles, dragonfly larvae, common stoneflies

Macroinvertebrates Respiration

Aquatic macroinvertebrates are animals and need oxygen to breathe. Aquatic macroinvertebrates can acquire dissolved oxygen across the surface of their bodies, but many types such as mayflies, damselflies, and stoneflies have elaborate branched, tufted or leaflike gills that help them obtain dissolved oxygen from the water. Still others have breathing tubes or siphons that they stick up above the surface of the water to breathe (water scorpions, mosquito larvae), while some aquatic beetles capture bubbles of air at the water's surface and dive down with their own portable "scuba tank".

Biological Assessment

Biological assessment uses the characteristics of biotic (living) communities, such as fish, invertebrates, amphibians, or plants to provide data about the biological "health" of a body of water. It allows us to detect an ecosystem's response to pollution and disturbance.
Measuring water quality alone (temperature, pH, heavy metals, etc) doesn't give a complete picture of river health. It isn't possible to test for every *contaminant* that might be present in a river or lake. Aquatic macroinvertebrates are excellent "bioindicators" I.e *biological indicators* of environmental health and ecological function. Since macroinvertebrates are confined to the aquatic environment for most or all of their life cycle, they integrate the effects of many stressors (sediment, temperature, pollution etc) over their lifespan. They are constantly exposed to whatever chemicals, sediments, or changes in the temperature that may be occurring in the river over time, and depending on the type of macroinvertebrate, may respond by dying out, migrating away, or reproducing in even higher numbers. Changes in the presence, condition, diversity, community, composition and relative abundances of specific groups of macroinvertebrates can indicate pollution or disturbance occurring in a river or its watershed.

Lesson Plan - Macroinvertebrates

Objective: Students will understand the importance of various types of native and invasive macroinvertebrates in the aquatic ecosystem and how they relate to salmon.

Macroinvertebrate Sampling and Identification: Introduction (5 Mins)

1. Introduce yourself and the station to the group. Ask students to introduce themselves.
2. **Ask students:** What do you already know about macroinvertebrates?
    a. **Ask:** What is an invertebrate?
    b. **Ask:** What does the word macro mean?
3. Describe to the learners that they will be field biologists searching for macroinvertebrates today.
    a. Briefly describe the in-river collection technique, safety protocols, and resources and guides they will be using to help them identify the macroinvertebrates that they collect.
4. Divide students into teams for each activity: collecting, sorting, identifying, etc.

Specimen Collection (15 Minutes)

1. Collect samples from a 1-square foot area immediately upstream from the net opening. To do this, approach the site from downstream. Hold the net downstream from the sample area, perpendicular to flow. Upstream, begin disturbing (rubbing with hand or shuffling with boot) rocks, stocks or other leaf litter to remove any invertebrates for 1-2 minutes. The invertebrates should flow into the net. Replace the rocks in the river.
    a. Note: **Make sure the area you collect from doesn't have salmon redds.** Redds are locations in the river that salmon and other fish use for spawning. Identify these areas by looking for 2 ft - 6 ft patches of rocks that have been stripped of their algae. These are sections that are "cleaner" than the surrounding river bottom, and they are usually located where there's a mix of fine gravel and larger cobble.
2. Dump net contents into a large shallow tray partially filled with water for sorting
3. Have students sort macroinvertebrates into separate ice cube trays. Remind them that the goal is to classify what species they find.
    a. Tip: It can help to use the analogy of a zoo when discussing the reasoning for sorting. In the zoo all animals are not in the same cage. You wouldn't see a lion in the same cage as an elephant; therefore we do our best to put all the mayflies with the mayflies and caddisflies with the caddisflies. This makes it easier to count and know how many of each type we are able to find.
5. Count and record the different species of macroinvertebrates.
    a. Insects can be divided by order (broad categories mayfly, stonefly, caddisfly, other groups). Use the dichotomous key and field guide to help with identification.
    b. Record these numbers on the Streamwebs data sheet provided with the equipment.

Application & Reflection (10 Minutes)

1. After you have finished identifying and recording **ask the group the following questions:**
    a. Why is it important to identify different types of macroinvertebrates?
    b. What does it mean for an organism to be tolerant of pollution? Intolerant of pollution?
    c. What can we tell about the water quality based on the organism we found?
    d. We are here to learn about salmon, so why do we care about macroinvertebrates?
2. Once the samples have been identified gently return the macroinvertebrates back to the river.

Appendix: Definitions

Biological Assessment - Using the characteristics of biotic (living) communities, such as fish, invertebrates, amphibians, or plants to provide data about the biological "health" of a body of water.

Bioindicators - A living organism, biological process, or community that indicates the health of an ecosystem and how it changes over time.

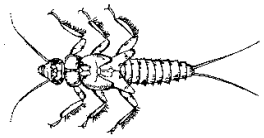
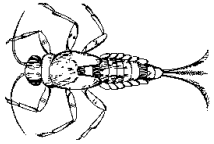
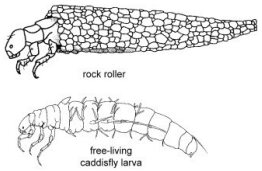
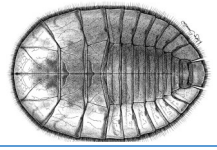
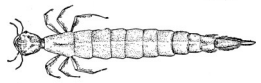
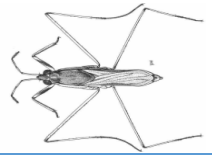
Contaminant - A polluting or poisonous substance that makes something impure.

Detritus - Dead or decomposing plant or animal matter.

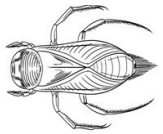
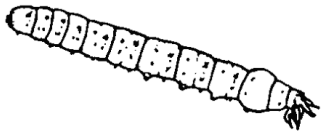
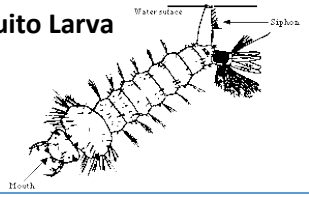
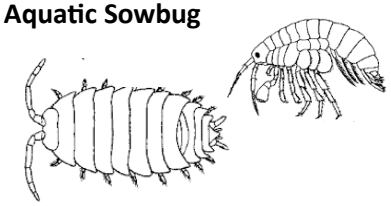
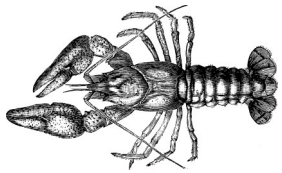
Functional Feeding Group - A way to categorize macroinvertebrates based upon their feeding behavior or mechanisms.

Quick Reference Guide to Aquatic Invertebrates

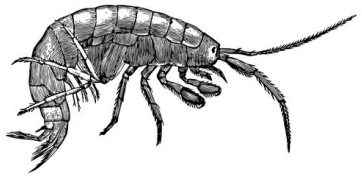
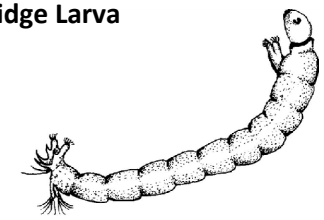
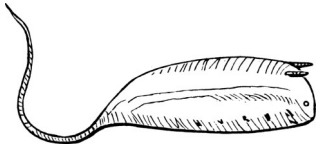
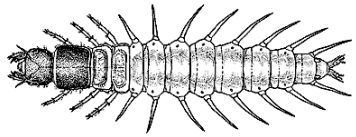
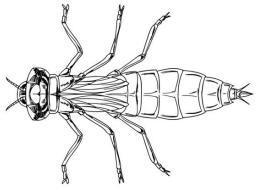
WORLD SALMON COUNCIL

Name	Distinguishing Characteristics	Where is it Found?	How Oxygen is Obtained	Food Gathering	Key Characteristics to look for
Stonefly Nymph 	2 Tails 2 sets wing pads (wing pads not always noticeable)	Cold running water	Through body surface, some small gills. Does “pushups” to increase oxygen flow.	Predator or herbivore	Streamlines body for crawling on rocks Requires high oxygen levels
Mayfly Nymph 	3 tails (sometimes 2) 1 set of wing pad	Cool or cold running water	Through gills along abdomen. May wave gills in water to increase oxygen flow.	Herbivore or scavenger	Requires high to medium oxygen levels
Caddisfly Larva 	Most Species build cases or nets soft body but some are free living	Cool or cold running water. Found in ponds	Through body surface. Some fingerlike gills	Filter feeder Herbivore Predator	Builds cases of heavy materials like rocks to avoid being swept away by fast flowing streams Uses grass and plants to make cases as well
Water Penny Larva 	Round, Flat, segmented, disk –like body.	Cold running water	Usually through gills on underside	Herbivore that grazes on algae	Flattened body resists pull of current
Predaceous Diving Beetle  Larval Stage  Adult Diving Beetle	Up to 6 cm long with robust jaws	In both still and moving water habitats	Through body surface	Voracious predator	Special channels in jaws to suck body fluids of prey
Water Strider (Adult) 	Skates on water’s surface	Ponds or still pools of streams	From atmosphere	Active predator	Can stay on water’s surface because feet have small surface area and are hydrophobic (water repellant)

Quick Reference Guide to Aquatic Invertebrates

Name	Distinguishing Characteristics	Where is it Found?	How Oxygen is Obtained	Food Gathering	Key Characteristics to look for
Water Boatman (Adult) 	Long swimming hairs or legs	Ponds or still pools of streams	From atmosphere by carrying air bubbles from the water's surface on body	Omnivore herbivore Or scavenger	Has swimming hairs on legs that act as oars
Backswimmer (Adult) 	Light colored underside Swims on back	Ponds or still pools of streams	From atmosphere by carrying air bubbles from the water's surface on body	Predator	Swim on back Have a sleek body shape
Cranefly Larva 	Cylindrical body Often has lobes at hind end. May also have small soft legs.	Bottoms of streams and ponds in sediment and algae	From atmosphere through openings called spiracles at hind end.	Active predator, herbivore or omnivore	Species that eats woody decaying matter. Have special gut bacteria top aid the digestion of cellulose.
Mosquito Larva 	Small body, floats at surface	Cool to warm still water	From atmosphere though breathing tube. Breathing tubes locates on hind legs in larva and on front ends as pupa	Scavenger, feeds on microorganism	Swims or dives when disturbed
Aquatic Sowbug 	Flattened body top to bottom 7 pairs of legs	Shallow freshwater, Among rocks and dead leaves	Through body surface on legs	Scavenger, Eats decaying matter Omnivore	Males clasps females under water's surface during mating. Females then shed half of their exoskeleton which is where fertilized eggs are placed.
Crayfish 	5 pairs of legs First pair is often robust. Looks like a small lobster.	Under rocks or in burrows in shallow freshwater	Through gills under their body	Scavenger or omnivore	Crawls backwards when disturbed. Males display some courtship behavior to reduce female aggressiveness.

Quick Reference Guide to Aquatic Invertebrates

Name	Distinguishing Characteristics	Where is it Found?	How Oxygen is Obtained	Food Gathering	Key Characteristics to look for
Scud 	Flattened body Swims side to side on its side	Bottom of lakes, Streams, or ponds.	Through gills under body	Scavenger or omnivore	Males carries females on its back during mating. Females then shed half of their exoskeleton which is where fertilized eggs are placed.
Midge Larva 	Small thin body with a hard head and small legs on hind end	Most still and moving water habitats	Through body surface with small gills	Predator, herbivore, or omnivore	Extremely common to find. Sometimes red because they have hemoglobin in their blood to help them transport oxygen. Wiggle actively.
Rat-Tailed Maggot Larva 	Cylindrical body, tail like breathing tube	Cool to warm water with low oxygen levels	From atmosphere through breathing tubes	Scavengers That eat decaying matter and sewage	Can survive low oxygen levels fatal to most other inverte-brates.
Dobsonfly Larva 	Large, long and slightly flattened	In soft substrate of slow moving water and under rocks	From atmosphere and through water using both gills and breathing tubes called spiracles.	Predator	Large pinchers on head; 7 - 8 pairs of lateral filaments on abdomen 3 pairs of legs on middle portion of body (thorax) with tiny pinch-ers at the end of each
Dragonfly Nymph 	Large eyes , No external gills Green, or brown in color Body is generally rough	Slow moving water in soft substrate, mud, or plant material	Through gills located on their rec-tum	Predator	Distinct scooping mouthparts that extend to catch prey No tails *May be confused with dam-selflies, but distinguishable by wide, oval abdomen and no tails

Key to Macroinvertebrate Life in the River

(Sizes of illustrations are not proportional.)

- Shells
  - Single Shell
    - *spiral, opening on left* — **Pouch Snail**
    - *spiral, opening on right* — **Gilled Snail**
    - *coiled* — **Orb Snail**
    - *conical* — **Limpet**
  - Double Shell
    - *small, whitish, tan or brown* — **Pill or Fingernail Clam**
    - *large, 2 to 8 inches, dark-colored* — **Freshwater Mussel**
- No Shells
  - Legs
    - 10+ Legs
      - *lobster-like* — **Crayfish**
      - *shrimp-like, swims on side* — **Scud or Amphipod**
      - *walks on bottom* — **Aquatic Sowbug or Isopod**
    - Four Pairs of Legs
      - *tiny, often brightly colored* — **Water Mite**
      - *runs on top of water* — **Fishing Spider**
    - Three Pairs of Legs
      - Wings
        - Beetle-Like, Wings Hard
          - *small, crawls on bottom* — **Riffle Beetle**
          - *swims moving hind legs alternating* — **Water Scavenger Beetle**
          - *back legs move at same time* — **Predaceous Diving Beetle**
          - *swims on surface* — **Whirligig Beetle**
          - *"Crawls" through water, spotted* — **Crawling Water Beetle**
        - Leathery Wings
          - *tan, lives on surface* — **Marsh Treader**
          - *dark, lives on surface* — **Water Strider**
          - *grasping front legs, up to three inches* — **Giant Water Bug**
          - *swims on back, back white* — **Backswimmer**
          - *swims right-side-up, back black* — **Water Boatman**
          - *long breathing tube, grasping front legs* — **Water Scorpion 'Nepa'**
          - *long, stick-like* — **Water Scorpion 'Ranatra'**
      - No Wings
        - No Obvious "Tails"
          - *brown, leatherlike, six legs, usually "C"-shaped* — **Riffle Beetle Larva**
          - *six legs and prolegs on abdomen* — **Pyralid Caterpillar**
          - *suction cup-like* — **Water Penny**
          - *large body, hinged mouth* — **Dragonfly Larva**
          - *green, tan, orange or white body* — **Caddisfly Larva**
          - *lives in stone case* — **Caddisfly Larva**
          - *lives in stick house* — **Caddisfly Larva**
        - One or Two "Tails"
          - *dark head, green or tan body, two brush-like tails* — **Caddisfly Larva**
          - *small, "spines" on side* — **Alderfly Larva**
          - *large mouth parts, "spines" on side* — **Dobsonfly Larva**
          - *"tails" long and stiff, long antennas* — **Stonefly Larva**
          - *flat gills on abdomen* — **Mayfly Larva**
          - *hangs from surface, large mouth parts* — **Predaceous Diving Beetle Larva**
        - Three "Tails"
          - *long "tails," gills on abdomen* — **Mayfly Larva**
          - *long "tails," gills on abdomen* — **Mayfly Larva**
          - *large legs, feathery gills* — **Mayfly Larva**
          - *plate-like "tails," no gills on abdomen* — **Damselfly Larva** (*side view of "tails"*)
- No Legs
  - With Tentacles, Brushes or "Tails"
    - *long breathing tube* — **Rat tailed Maggot Larva**
    - *two fringed "tails"* — **Water Snipe Fly Larva**
    - *smooth, "stiff," small head* — **Horse Fly Larva**
    - *large, grey with tentacles* — **Crane Fly Larva**
    - *white or grey with tentacles* — **Crane Fly Larva**
    - *big "head," active* — **Midge Pupa**
    - *black, attaches to hard surfaces* — **Black Fly Larva**
  - Worm-Like
    - *Suckers, expands and contracts, body segmented* — **Leech**
    - *reddish brown, segmented body* — **Tubifex Worm**
    - *glides along bottom, body not segmented* — **Flatworm or Planaria**
    - *tan to brown, long* — **Horsehair Worm**
    - *body with bristles, no suckers* — **Bristle Worm**
    - *distinct head, red, green or tan, twists* — **Midge Larva**
    - *small, hair-like, swims in "S" shape* — **Nematode or Threadworm**
  - Microscopic
    - *apostrophe-shaped* — **Cyclops or Copepod**
    - *round* — **Seed and Clam Shrimp**
    - *swims with a jerk, using antennas* — **Water Flea or Daphnia**

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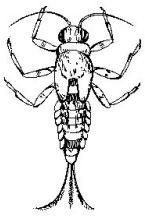
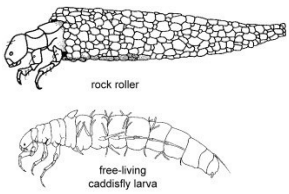
Pollution Tolerance Group Key

WORLD SALMON COUNCIL

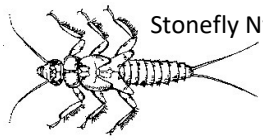
Group 1: These organisms are very intolerant of pollution.

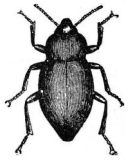
Samples with high numbers of these macroinvertebrates signifies Good—Excellent water quality.

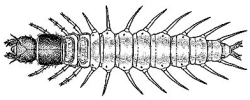

Mayfly Nymph

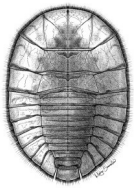


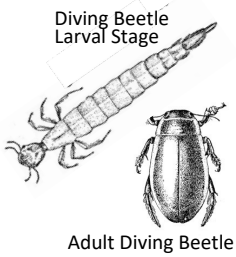
Caddisfly Larva


Stonefly Nymph


Riffle Beetle


Dobson Fly Larva


Water Penny



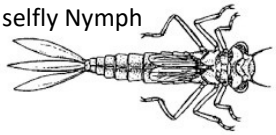
Adult Diving Beetle

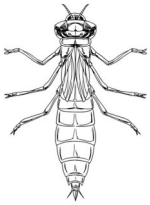

Right Hand Snail

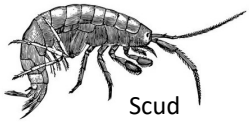
Group 2: These organisms are fairly tolerant of pollution.

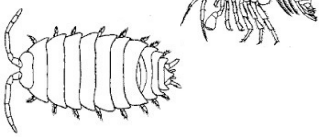
Samples with high numbers of these macroinvertebrates signifies Poor—Fairwater quality.

Freshwater Clams or Mussels


Damselfly Nymph

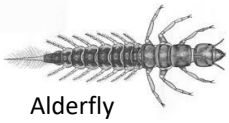

Dragonfly Nymph


Scud


Aquatic Sowbug


Crayfish

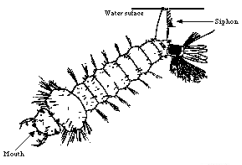

Cranefly Larva


Alderfly

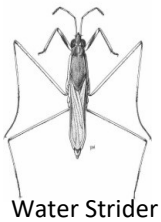
Group 3: These organisms are tolerant of pollution.

Samples with high numbers of these macroinvertebrates signifies Poor water quality.


Leech



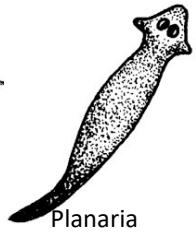
Mosquito Larva


Water Strider

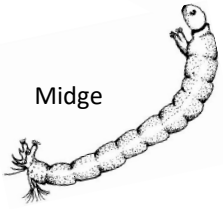

Aquatic Worm


Water Boatman


Backswimmer


Planaria
or Flatworm


Rat-tailed Maggot


Midge


Left Hand Snail

OSU Oregon State University Extension Service

StreamWebs™
Student Stewardship Network

MACROINVERTEBRATE SAMPLING

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

Name:_____

School: _____ Teacher: _____

Date: _____ Time: _____ Weather: _____

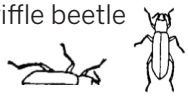
Stream/Site Name: _____ Time spent sorting/identifying: _____

# of people sorting/identifying: _____ ☐ Riffle ☐ Pool

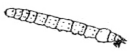
Directions:
1. Record the number of each type of organism found in the # found column of each section.
2. Then circle the number in the score column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

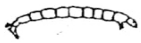
Sensitive / Intolerant

	# found	score
caddisfly 		3
mayfly 		3
riffle beetle 		3
stonefly 		3
water penny 		3
dobsonfly 		3
Sensitive TOTAL =		

Somewhat Sensitive

	# found	score
clam/mussel 		2
crane fly 		2
crayfish 		2
damselfly 		2
dragonfly 		2
scud 		2
fishfly 		2
alderfly 		2
mite 		2
Somewhat Sensitive TOTAL =		

Tolerant

	# found	score
aquatic worm 		1
blackfly 		1
leech 		1
midge 		1
snail 		1
mosquito larva 		1
Tolerant TOTAL =		

\+ ☐ Sensitive total
\+ ☐ Somewhat sensitive total
☐ Tolerant total
= ☐ **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

Adapted from: Environmental Services City of Portland

StreamWebs™
Student Stewardship Network

OSU Oregon State University Extension Service

MUESTREO DE MACROINVERTEBRADOS

Comparta sus datos de campo rápida y fácilmente con StreamWebs. Averigüe lo que los macro invertebrados que encontró dicen acerca del arroyo, hacer un seguimiento de sus puntos de foto, graficar los datos de calidad del agua, subir un video y mucho más.

www.streamwebs.org

Nombre:_____

Escuela: _____ Profesor: _____

Fecha: _____ Hora: _____ Clima: _____

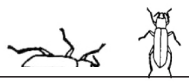
Nombre del arroyo/sitio: _____ Tiempo de clasificación/identificación: _____

de personas que clasifican/identifican: _____ ☐ Ráfaga ☐ Piscina

Instrucciones:
1. Anote el número de cada tipo de organismo encontrado en la columna # encontrada de cada sección.
2. Luego circule el número en la columna de puntuación (3, 2 o 1) si se encuentra alguno de ese organismo.
3. Luego circule el número en la columna de puntuación (3, 2 o 1) si se encuentra alguno de ese organismo.

SENSIBILIDAD A LA CONTAMINACIÓN

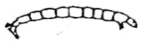
Sensitivo / Intolerante

	# encontrada	puntuación
canutillo 		3
mosca de mayo 		3
escarabajo de agua 		3
mosca de las piedras 		3
penique de agua 		3
mosca de dobson 		3
Sensitivo TOTAL =		

Algo sensible

	# encontrada	puntuación
mejillón de río 		2
típula 		2
cangrejo de río 		2
caballito del diablo 		2
libélula 		2
gambas de río 		2
mosca de pescado 		2
pérlido 		2
ácaros de río 		2
Algo sensible TOTAL =		

Tolerante

	# encontrada	puntuación
gusano acuático 		1
mosca negra 		1
sanguijuela 		1
mosquito no picador 		1
caracoles de río 		1
larva de mosquito 		1
Tolerante TOTAL =		

\+ ☐ Sensitivo total
\+ ☐ Algo sensible total
\+ ☐ Tolerante total
= ☐ Calidad del agua

☐ Excelente (>22) ☐ Buena (17-22)
☐ Regular (11-16) ☐ Pobre (<11)

Adaptado de: Environmental Services
City of Portland