

## **IDENTIFY AQUATIC MACROINVERTEBRATE INSECTS**

By Dennis Segura, aquatic sport fishing education coordinator, Department of Game and Fish

Because of their small size, we usually forget that insects are part of the animal kingdom. In fact, insects are the largest and one of the most successful and diverse group of animals on the planet, with an estimated 30 million species!

A small group of insects called **Macroinvertebrate Aquatic Insects** spend at least part or the majority of their lives in cold water and make up the bulk of a trout's diet.

Besides being a food source, aquatic insects provide a valuable habitat service by eating dead or decaying bacteria, plants and animals while recycling important nutrients back into the water. They are very good indicators of water quality because they are easily affected by the chemical, physical and biological conditions of the water they live in.

Being able to identify aquatic insects by looking under rocks in the shallow parts of a mountain stream, river, pond or lake can help you determine what the fish are feeding on and, depending on the insects you find, determine the cleanliness of the water.

### **OBJECTIVES:**

**Kids will be able to:**

1. Safely collect aquatic insects from the shallow part of a river, stream or pond.
2. Identify the number and type of aquatic insect they have collected.
3. Determine which level of pollution tolerance each insect type belongs to.
4. Identify the exterior body parts of an aquatic insect.
5. Determine the feeding types of aquatic insects.

### **ACTIVITIES:**

1. Identify an Aquatic Insect's External Body Parts
2. Identify Aquatic Insects & Pollution Tolerance
3. Charting Aquatic Insect Feeding Types
4. Extension Exercise # 1 – Aquatic Insect Breathing Types
5. Extension Exercise # 2 – Estimate the EPT Index of the Water

### **METHOD:**

#### **1. COLLECT AQUATIC INSECTS.**

Kids will collect aquatic insects by picking up submerged rocks in shallow water and looking underneath the rocks where they can find the insects clinging to the bottom. If the rocks are a bit stuck in the mud, kids can kick the rocks over gently and pick it up. Remove the aquatic insects from the rock and put them in a shallow tray or small bucket filled with river water 1/3 of capacity.

**NOTE – Never allow children to get into a body of water by themselves and never enter fast flowing rivers, especially during the spring runoff! Stay near the bank in shallow water below the knees and look for river rocks to turn over. Wear hip waders or old shoes to get in the water. Never walk barefoot in the water— there may be rusty hooks!**

**2. GET A GOOD LOOK AT THESE INSECTS.**

- a. Kids will use a small fish net to take the insects out of the bucket and put them in a light-colored shallow tray filled with river water. Shallow trays allow you to get a good look at the different bugs.
- b. Use the plastic spoons to scoop each insect up out of the tray and place in your hand or a petri dish filled with water, especially for swimming insects. Emphasize to kids that the insects are harmless and do not bite or sting.
- c. Use a magnifying glass to see the details such as eyes, color, legs, gills etc.

**NOTE – Please return all aquatic insects to the water at the same location you found them!**

- 3. RECORD THE INFORMATION.** Use Activities #1, #2 and # 3 as well as Extension Activities # 1 and # 2 to record information you have gathered.

**MATERIALS NEEDED:**

- A clean bucket, a two to three-inch-deep shallow tray, small fish net from pet store, plastic spoons and a magnifying glass/glasses. Recommended: hip waders, petri dishes.
- Copies of Macroinvertebrate Life in a River Key # 1 and Macroinvertebrate Identification Key # 2.
- Copy of Information Sheet for Activity # 3 Aquatic Feeding Types.
- Copy of Activity # 1 Identify the Exterior Parts of an Aquatic Insect.
- Copy of Activity # 2 Identify Aquatic Insects.
- Copy of Activity # 3 Charting Aquatic Insect Feeding Types.
- Copy of Extension Exercise # 1 Aquatic Insect Breathing Types.
- Copy of Extension Exercise # 2 Estimate the EPT Index of the Water.

**OVERVIEW: Under adult supervision,** kids will get into the shallow part of a river or stream next to the bank and turn rocks over looking for aquatic insects clinging to them. They will collect the insects by putting them in a clean bucket filled 1/3 with river water.

After they are done collecting insects they will use pet-fish nets to carefully remove insects from the bucket for viewing in a shallow tray filled with river water. Using a magnifying glass, the kids will refer to Chart # 1 to determine what insects they have found and give a brief description of each insect.

Students will then determine if the insects are in one of four categories; Group # 1 Very Intolerant of Pollution, Group # 2 Fairly Intolerant of Pollution, Group # 3 Moderately Tolerant of Pollution or Group # 4 Very Tolerant of Pollution.

Next, they will then determine the feeding type of the different insects they collected. To further their studies, the kids can do Extension Exercise # 1 Aquatic Insect Breathing Table and Exercise # 2 Estimate the EPT Index of the Water.

### **VOCABULARY:**

**Macro** – Means large, or something you can see easily with your eyes.

**Invertebrate** – A living creature lacking a backbone such as insects. 95% of the world's animal species are invertebrates.

**Aquatic** – Living in or near water. For example, an aquatic animal, either vertebrate (fish) or invertebrate (Insects), which lives in water for most or all of its life.

**Macroinvertebrate Aquatic Insects** – Includes insects in their larval or nymph forms. Most live part or most of their life cycle submerged in water attached to the bottom of rocks, logs and vegetation.

**Larval** – The juvenile form of an insect after hatching from an egg.

**Nymph** – The immature form of insects. During the nymph stage insects undergo a gradual metamorphosis (a physical change) from the immature stage to its adult stage.

**Metamorphosis** – The process of changing from an immature form to a mature form. For example, caterpillars turn into butterflies.

**Intolerant** – The ability to not be able to survive something harmful or unpleasant.

**Tolerant** – The ability to survive something harmful or unpleasant.

**Respiration** – The action of breathing.

**Digestion** – The process of breaking down food for energy.

**Mandibles** - A pair of appendages near the insect's mouth, their function is to grasp, crush or cut the insect's food, or to defend against predators or rivals.

**Appendages** – A projecting part of a living organism such as legs, mandibles or antenna with a distinct appearance or function. Aquatic insect legs are used to walk and to cling on to rocks.

**Crustaceans** - Crustaceans form a large, diverse aquatic group which includes fresh and salt water animals such as crabs, lobsters, crayfish, shrimp, prawns and krill.

**Decaying** - To decay means to rot, decompose or break down. Our bodies—anything organic—will decay after death.

**Organic** - Anything relating to or originating from living matter, plant or animal.

**Organic Material** – Dead, decaying plant and animal matter found in the water.

### Common Aquatic Insects:

- **Mayflies**                      - **Dragonflies**
- **Stoneflies**                   - **Damselflies**
- **Caddisflies**                 - **Beetles**
- **Midges**                        - **Dobson Flies**
- **Crayfish** – Crayfish are not insects but large crustaceans.
- **Scuds** - Scuds are small crustaceans, sometimes called “freshwater shrimp.”

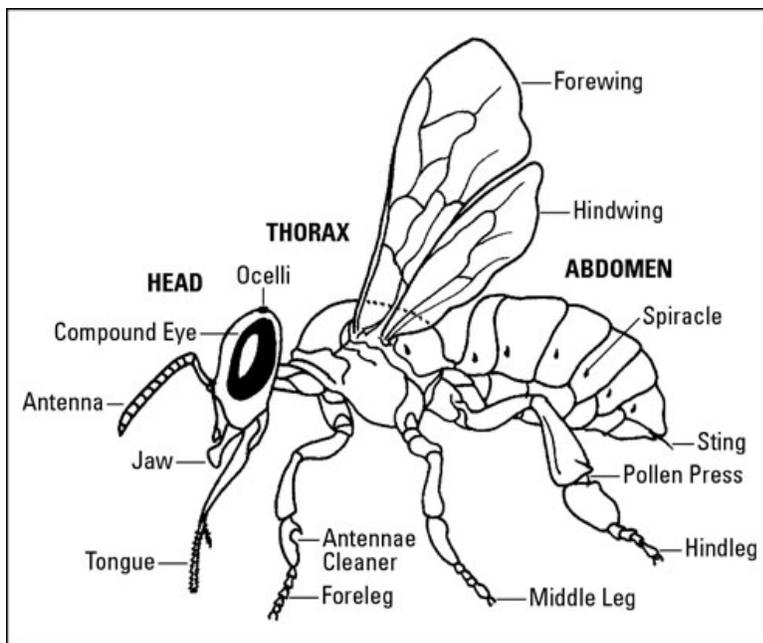
### ACTIVITY # 1 - IDENTIFY AN AQUATIC INSECT’S EXTERNAL BODY PARTS

**Features of Aquatic Insects** - Aquatic insects have basic external features that are found in all insects. They have **six legs** and a hard, outer protective covering called an **exoskeleton** and three main body parts: the **head, thorax and abdomen**.

- The **head** of an insect has the eyes, mouth and antennae and processes sensory information.
- The **thorax** connects the head to the abdomen and has three legs on each side and usually a pair of wings. The thorax is responsible for movement.
- The **abdomen** is where digestion, respiration, excretion and reproduction occur.

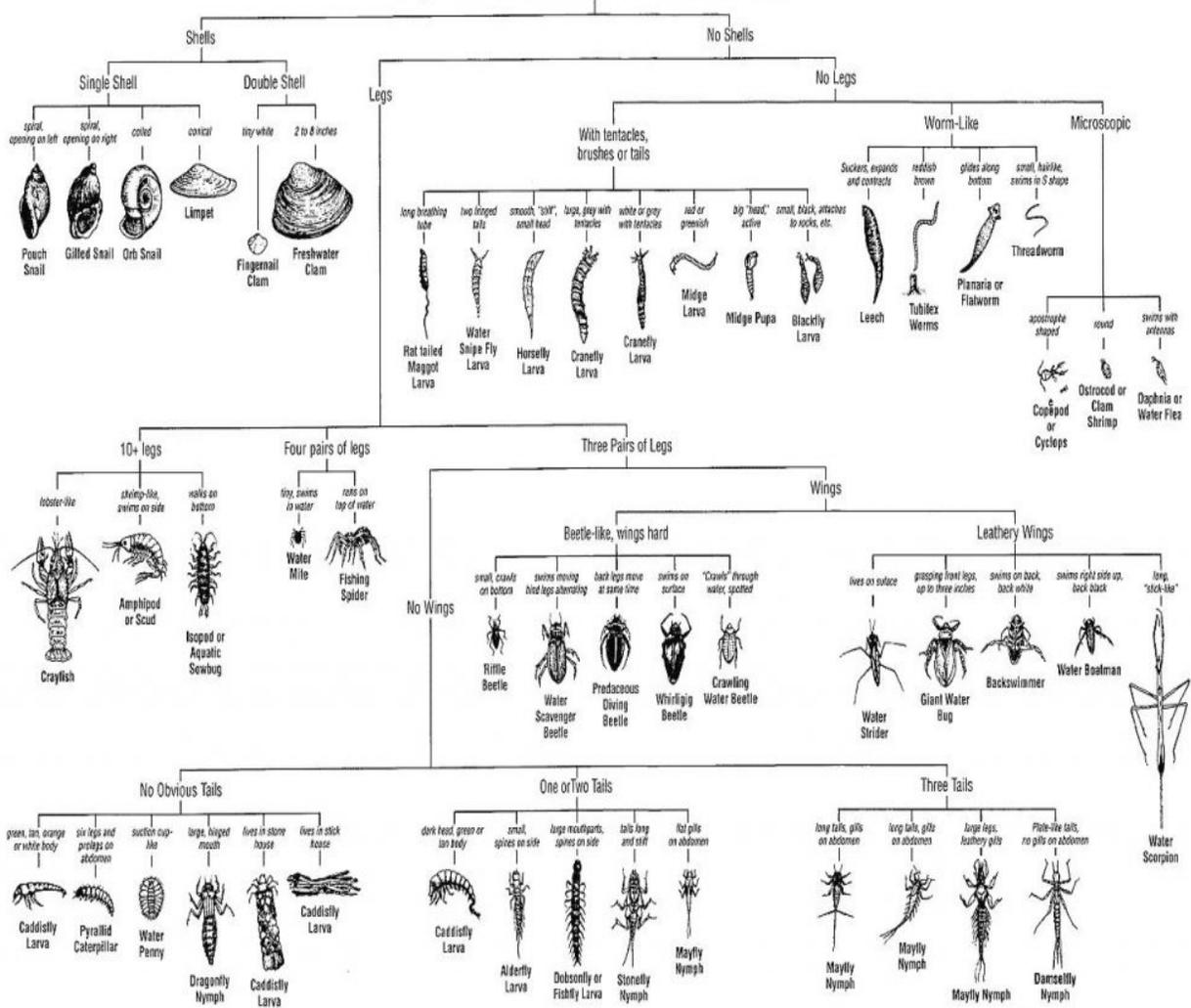
#### INSTRUCTIONS - Label the following body parts:

- A. Head – 1. Antenna 2. Eyes 3. Mouth
- B. Thorax - 1. Legs 2. Wings 3. Gills
- C. Abdomen – 1. Tail 2. Gills



# MACROINVERTEBRATE LIFE IN THE RIVER KEY # 1

## Key to Macroinvertebrate Life in the River



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## ACTIVITY # 2: IDENTIFY AQUATIC INSECTS

Use **key # 1** to **identify what types of aquatic insects** you found. Next, mark an X in each box to indicate how many of each types of insects you caught. If you caught two stoneflies mark an “X” in two boxes in the stonefly column starting from the bottom to the top.

Next, use **key # 2** to **determine each insect’s pollution tolerance level** by coloring each particular insect’s column one of the following colors.

**Blue** = Very Intolerant of pollution. These insects only thrive in very clean water.

**Green** = Fairly Intolerant of pollution. These insects thrive in very clean to clean water.

**Yellow** = Moderately Tolerant of pollution. These insects thrive in clean to slightly polluted water.

**Red** = Very Tolerant of pollution. These insects thrive in polluted water.

**EXAMPLE:**

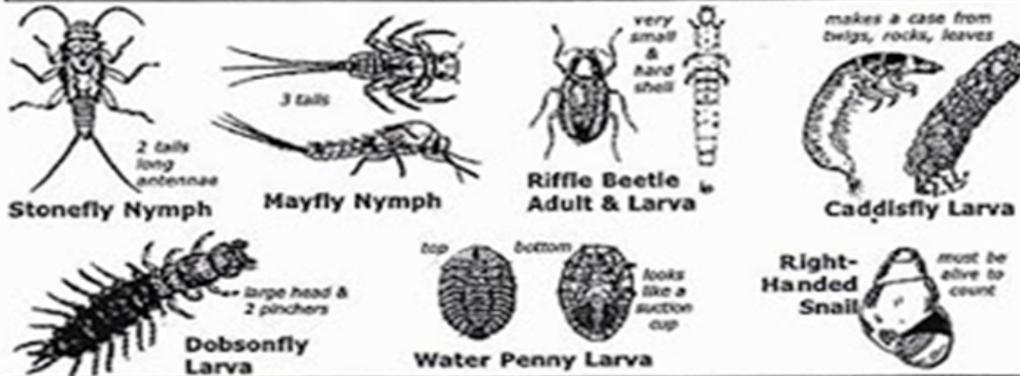
X									
X			X					X	X
Stone Fly	May Fly	Caddis Fly	Midge Larva	Scuds	Damsel Fly	Dragon Fly	Beetle	Crayfish	Other Aquatic Worm

Stone Fly	May Fly	Caddis Fly	Midge Larva	Scuds	Damsel Fly	Dragon Fly	Beetle	Crayfish	Other

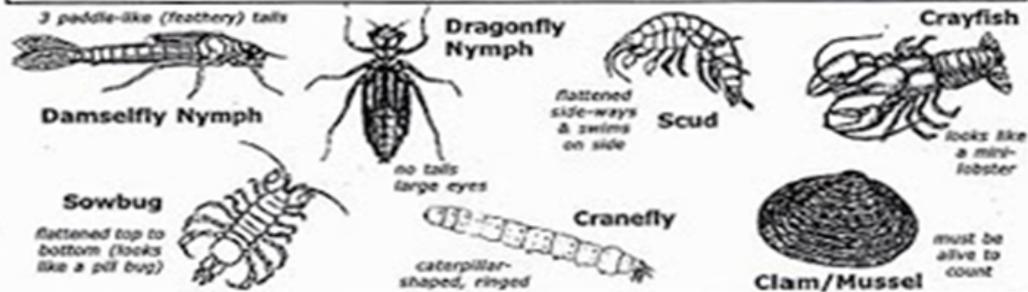
## MACROINVERTEBRATE IDENTIFICATION KEY # 2

### Macroinvertebrate Identification Key

#### GROUP 1 – Very Intolerant of Pollution



#### GROUP 2 – Moderately Intolerant of Pollution



#### GROUP 3 – Fairly Tolerant of Pollution



#### GROUP 4 – Very Tolerant of Pollution



### INFORMATION SHEET FOR ACTIVITY # 3

**AQUATIC INSECT FEEDING TYPES** - Aquatic insects can be categorized into four groups called “**Functional Feeding Groups**” that are based on the type of food they eat. Some insects may fall into more than one feeding group.

1. **PREDATORS:** These insects attack and eat other aquatic macroinvertebrates. There are seven types of aquatic predatory aquatic insects based on their ability to move or cling.

**Clingers:** Have bodies that are good at maintaining a solid position on firm surfaces like rocks above and below the water surface.

water pennies, caddis flies, black flies, snails, flatworms, leeches.

**Climbers:** Have adapted to live on aquatic plants.

Damselflies, dragonflies.

**Crawlers:** Lives on a solid surface and seeks out protected places among pebbles or rocks.

Hellgrammites, stoneflies, mayflies.

**Sprawlers:** Lives on sand, silt or clay. Flattened bodies, legs extend out so they can maintain their bodies on top of the sand and not sink below.

Dragonflies, some caddis flies.

**Burrowers:** These insects like to dig themselves down into the sand, silt or clay.

Mayflies, midges, aquatic earthworms, dragonflies, some crayfish.

**Swimmers:** These insects move their entire bodies like a fish would to swim.

Minnow mayflies, mosquitoes.

**Skaters:** Surface water movement gently without breaking through the film created by surface.

Water striders.

2. **COLLECTORS:** These insects gather organic material that is floating in the water or deposited in the rocky bottom of the water.

Mayflies, stoneflies, midges, caddisflies and blackflies.

3. **SCRAPERS:** These insects feed on surfaces on the bottom of a river, scraping off attached algae, micro-organisms and deposited organic sediments.

Mayflies and caddisflies.

4. **SHREDDERS:** These insects shred and chew leaves and bark found in the water.

Stoneflies, caddisflies and crane flies.



# EXTENSION INVESTIGATION ACTIVITY # 1:

## AQUATIC INSECT BREATHING TYPES:

Aquatic insects have adapted to breathing oxygen that has dissolved in the water. Using a search engine, research the aquatic insects you caught and determine how each specific type breathes.

- Some aquatic insects have **gills** like a fish to breathe.
- Other insects can **exchange gas through their skin** to breathe.
- Some aquatic insects take a **bubble of air** down with them to periodically breathe from.
- A few aquatic insects **breathe through a tube** sticking up out of the water like a snorkel.

**INSTRUCTIONS** – Name the different insects you found under the ‘Insect Type’ column. Next, place an X to indicate if the insect breathes through gills, gas exchange, bubbles or a breathing tube.

INSECT TYPE	Gills	Gas Exchange	Bubble of Air	Breathing Tube
Ex. Water Beetle			X	

NOTES:

## EXTENSION INVESTIGATION ACTIVITY # 2:

### ESTIMATING THE EPT INDEX OF THE WATER.

The **EPT Index** is the total number of distinct taxa (families) within the following three aquatic insect groups that thrive in only the cleanest water.

1. **Ephemeroptera**, or Mayflies
2. **Plecoptera**, or Stoneflies
3. **Trichoptera**, or Caddisflies.

For example, if five species of **Ephemeroptera** (mayflies), five **Plecoptera** (stoneflies) and two **Trichoptera** (caddisflies) are found at a site, the total number of **EPT** taxa and **Index** would equal 12. This would mean excellent water quality and a healthy aquatic habitat according to the table found below.

Instructions:

Sort and identify the macroinvertebrate insects using the magnifying glasses, petri dishes and **Chart # 1, Key to Macroinvertebrate Life in a River**. List the number of different families on the table below and calculate an EPT index.

**NOTE:** A low EPT value does not always mean poor water quality. **Factors other than pollution**, such as physical characteristics of the stream or river, **may cause the absence of some aquatic invertebrates**.

Aquatic Insect Group (orders)	Number of different taxa found
Ephemeroptera (Mayflies)	
Plecoptera (Stoneflies)	
Trichoptera (Caddisflies)	
<b>TOTAL</b>	

Total taxa "families" equals EPT Value:

Greater than 10 total families = Water not affected (excellent water quality)

6-10 total families = Water slightly affected (good water quality)

2-5 total families = Water moderately affected (fair water quality)

Less than 2 total families = Water severely affected (poor water quality)

**ANALYSIS** – Answer the following questions based on the information you learned and the insects you collected for the specific section of water you investigated.

**QUESTIONS:**

1. How many different kinds of aquatic insects did you find?
2. What were the three most common aquatic insects you found?
3. What were the most common feeding type of aquatic insect you collected?
4. What level of pollution tolerance do most of the insects you collected belong to?
5. How do you know if the water you found the aquatic insects in is clean and healthy?
6. How does the type and number of aquatic insects affect the fish living in the same habitat of water?
7. Would the fish be healthy to eat from the water you found the aquatic insects in?
8. Were there any factors that may have influenced your EPT Index for water cleanliness?
9. Why are aquatic insects important to anglers?

**ANSWERS:**

The responses will vary depending on where the insects were found, what the condition the water is in and if there were factors influencing the presence of insects.

1. Answers will vary.
2. Answers will vary.
3. Answers will vary but Predators will most likely be the largest feeding group.
4. Again, answers will vary depending on the insects collected.
5. This answer depends on the types of insects you found and their pollution tolerance level.
6. The more aquatic insects in the water the better the feeding is for the fish. Also, depending on the pollution tolerance level of the insects the water quality might affect the fish as well.
7. Again, it depends on the pollution tolerance of the insects found in the water.
8. Example could be few to no rocks or plants in the water, water temperature or possible pollution.
9. Aquatic insects not only provide food for trout to feed on, meaning bigger healthier fish to catch, but they can also tell anglers which artificial flies to use and what insects the fish are feeding on. Of course, insects tell us how clean the water is and finally insects also serve as a blueprint for tying artificial flies.