Benthic Macroinvertebrate Lab
Ecology and Sorting Lesson Plan *(version 1.1, Jan. 2006)*

Overview

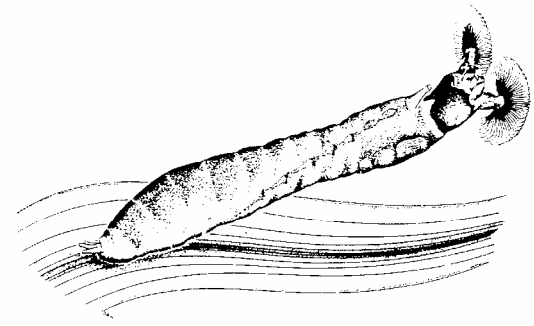
This lesson plan assumes you have gathered a sample of benthic macroinvertebrates to analyze in class. Prior to sorting the sample, introduce insect morphology (shape of), taxonomy, and ecological adaptions and behavior. This lesson plan provides three activities including:

- **Activity 1:** Teaching students how to identify body parts and shapes of the insects (insect morphology)
- **Activity 2:** Having students draw an insect and explore how two insects move, eat, fit in a food chain, and the pollution tolerance of the insects.
- **Activity 3:** Sorting and recording many if not all of bugs you collected.

Activity 1

Use drawings of benthic macroinvertebrate insects to teach taxonomy as it relates to the morphology of the organism. Put these drawing on overhead projection sheets. You can use the attached graphics or create your own.

Find dry-erase pens of at least 4 colors. Project the overhead sheets and use the pens to identify the head, thorax and abdomen and breathing apparatus of the creature if obvious.



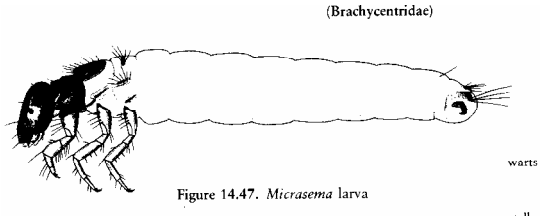


Figure 14.47. *Micrasema* larva

Blackfly larvae
Order: Diptera Family: Simulidae

Equipment and materials list

Activity 1: Morphology and taxonomy

- ❖ Overhead sheets of insects
- ❖ Colored pens
- ❖ Photocopies of insects for students to color in
- ❖ Colored pencils for students

Activity 2: Adaptations and behavior

- ❖ Student worksheet: Benthic adaptations and behavior
- ❖ Colored pencils for student drawing
- ❖ Watershed Watch Key to Orders
- ❖ Laminated card sets of the NM Department of Game and Fish poster on benthic macroinvertebrates
- ❖ Reference books such as the Reese Voshell book on North American aquatic insects
- ❖ Extra: Audio recording of benthic insects songs by David Dunn

Activity 3: Sorting insects

- ❖ Sorting trays
- ❖ Forceps
- ❖ Eye droppers
- ❖ Petri dishes, labeled
- ❖ Benthic macroinvertebrate sorting and recording sheet
- ❖ Multiple types of insect keys. NMWW key to orders is primary reference
- ❖ Microscopes
- ❖ Sieve bucket
- ❖ Glass vials for a reference collection
- ❖ Brush for cleaning out sieve bucket
- ❖ Subsample tray if the entire sample is very large (over 300 insects)

(continued activity 1 description)

Have the students draw critique how you do the drawings. Don't be afraid of purposely making a mistake to see if they catch you. Have them come up and indicate the parts of other insects with colored pens.

Activity 2

Introduce the students to concepts of why insects behave differently and how that affects their shape, movement, eating styles, and place in the food chain. Also discuss the topic of tolerance to pollution. Present 2-3 insects on the overhead projector and review these items. Two good resources to have on hand are Reese Voshell's Guide to Common Freshwater Intertebrates of North America for preparing yourself for this activity and to have in the classroom.

Pass out the worksheet and the Watershed Watch Key to Orders. Also pass out laminated card sets of the NM Department of Game and Fish poster on benthic macroinvertebrates.

Bosque School student fills in a scud

Ask the students to draw two insects from the guide as they pay close attention to the insects body parts. Then ask them to put "X"s in the right area to indicate the insects adaptations and behavior for the four areas of:

- ❖ Moving
- ❖ Eating Style
- ❖ Place in Food Chain
- ❖ Pollution Tolerance

Tell the students to take their best guess at the appropriate characteristics if they can't find the information or don't have time to research it during the class period. You might ask students to draw particular insects that you know they'll find in your river sample.

Activity 3

Spread out white paper over lab tables that are black. The paper provides a bright background for observing and identifying key characteristics of insects floating in Petri dishes. Put on the table:

- ❖ White tray with about ¼ inche of water and unsorted insect sample
- ❖ Labelled Petri dishes sitting on the white
- ❖ 3-4 pairs of forceps and at least one eye dropper
- ❖ Microscope, about 10-40X
- ❖ Watershed Watch Order Key plus any other keys you have available
- ❖ Benthic macroinvertebrate sorting and recording sheet

Kit of station material (not including eye dropper)

Step 1: Identify insects & begin sorting
Ask students to identify insects and sort them into Petri dishes. I find that many students really get into exploring what's in the tray. All the exploring is important. But also remember that they may not be interested in or you may not have time to come back to this activity the next day.

You may need to subsample the entire bug sample prior to providing students with trays of insects to sort. Subsampling is valuable in saving time if you have a large number of insects, say 500 – 1000. Look in the Watershed Watch Workbook Appedices for the proper subsampling method.

I suggest that after some exploration ask them to identify one insect correctly then sort all of that insect into the appropriate Petri dish.

Some of the tricks I've learned are:

- ❖ Have them focus on looking for smaller insects, not just the larger ones.
- ❖ Ask them to carefully clean out leaves and sticks for samples with lots of detritus first. Ask them to look over the materials they remove carefully, dip it in water in the tray to remove insects, and place the material outside the tray.

Step 2: Verify identifications
Verify and correct the students' identifications as they are sorting. I usually point out common patterns for small mayflies, midges, or blackflies. For instance, I show ask them to identify or I show them key features with bare eyes after they've seen a small mayfly under a microscope. The ability to identify key features with bare eyes speeds the sorting process.

When a correction has been made for a common misidentification you might address the entire class about the correct identification.

Step 3: Recording results
Pass out the Benthic macroinvertebrate sorting and recording sheet to each work group. Ask them to complete their sorting. Make a table on a board or large sheet of paper that is similar to the recording sheet at the front of the class as they take about 5 minutes to do this. Then ask them to tally by category the number of insects they have in each Petri dish. Go around the

room and add up each work groups count of each insect category. Derive a total of all insects sorted once all categories have been counted.

Do some simple summary calculations shown at the bottom of the sorting and recording sheet. The percentages of each type of insect provides an indication of health of the stream. Discuss with students the health of the stream as it relates to what they found.

Keep this recording sheet in a safe place for reporting.

Step 4: Preserving reference collection and the entire sample, if desired. Use glass vials filled with alchol to preserve identified insects or representative samples of them. For a viewable reference collection store the insects in the display rack provided by the New Mexico Department of Game and Fish. Make sure you use a pencil to label a small sheet of paper with the name of the insect, date of collection, and river location where it was taken.

You can also put unknown insects in a vial for identification later.

For long-term storage and verification by a professional taxonomist, put the vials with all the sorted insects inside the mason jar that you used originally to store the bug sample. Put any unsorted bugs that were not taken in the subsample in the mason jar also. Label the mason jar with the date of sampling, data of analysis and location of sampling site.

Bosque School students use the Watershed Watch Key to Orders, microscopes and forceps to sort a sample from Las Huertas Creek in Sandoval County.

Name: _____ Date: _____

Benthic Macroinvertebrate Adaptations & Behavior

Select two organisms from the Watershed Watch Order Key, draw each in the boxes including key features. Then research or use your imagination to identify the behaviors and adaptions. Use **Reese Voshell** Jr's book *A Guide to Common Freshwater Invertebrates of North America* as a primary reference, if possible. Check the box to right with your best estimate.

Moving
___ Jumper, ___ Floater, ___ Climber, ___ Skater, ___ Swimmer,
___ Crawler, ___ Burrower, ___ Clinger

Eating Style
___ Scraper, ___ Shredder,
___ Collector (filterer), ___Predator

Place in Food Chain
___ Herbivore (eats plants), ___ Carnivore (eats animals), ___ Omnivore (eats plants and animals), ___ Detrtivore (eats dead and decaying matter)

Tolerance to Pollution
___ Intolerant (suggests good water quality),
___ Somewhat tolerant(wide range of quality
___ Tolerant (suggests poor water quality)

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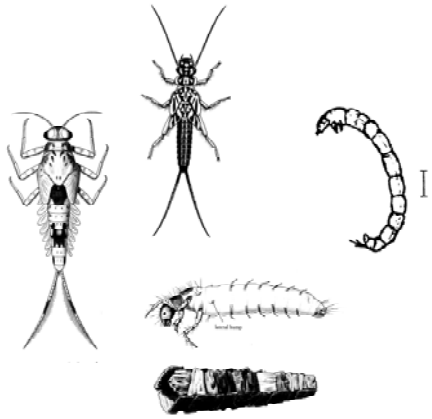
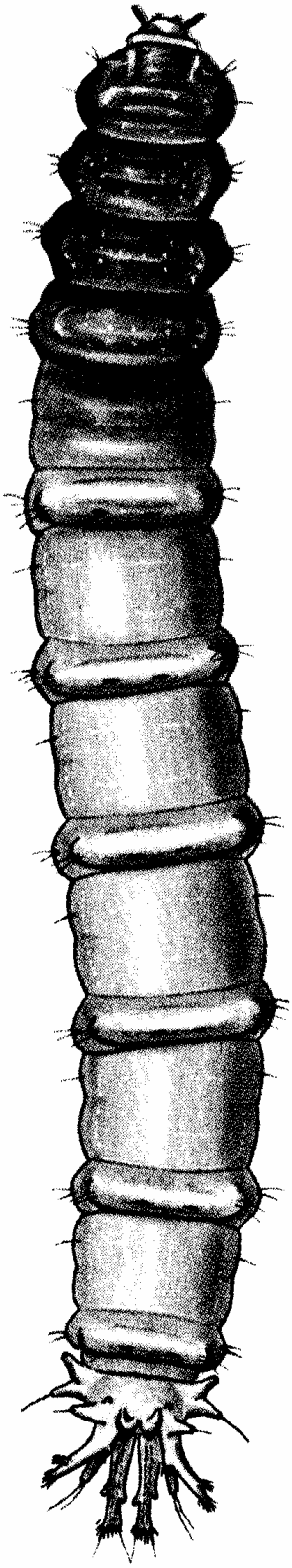
Benthic Macroinvertebrate Sorting & Recording Sheet



Stream name:	
Site name:	
Date of Sampling:	
Date of counting bugs & completing sheet:	
Names of bug sorters & counters:	

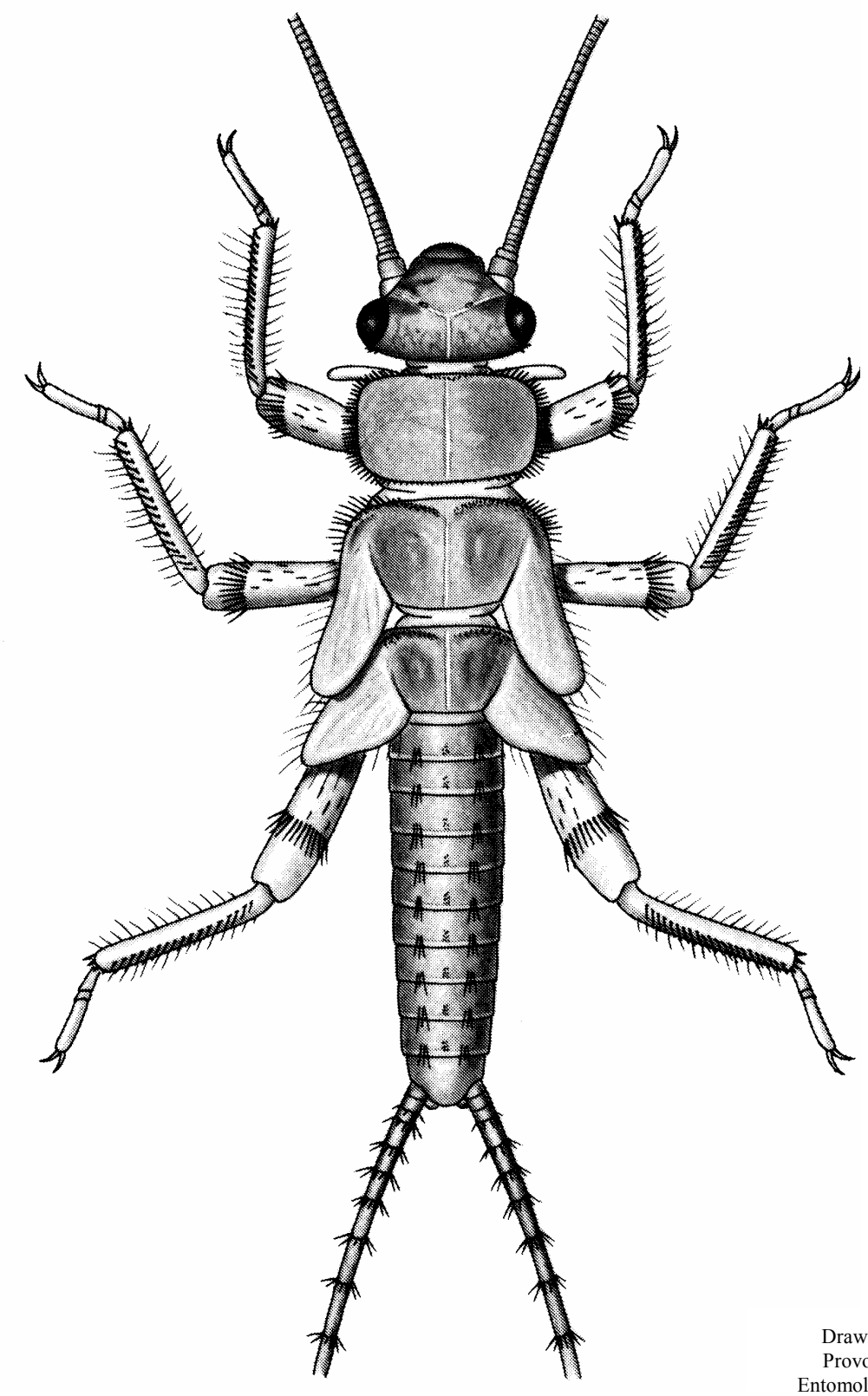
Scientific Name of Group	**Common Name**	**Number found**	**% of total**
Order: EPHEMEROPTERA	Mayflies		
Order: PLECOPTERA	Stoneflies		
Order: TRICHOPTERA	Caddisflies		
Order: DIPTERA, *Family: CHIRONOMIDAE*	Midges		
Order: DIPTERA, *Family: SIMULIIDAE*	Blackflies		
Order: DIPTERA, *Family: TIPULIDAE*	Craneflies		
Order: COLEOPTERA	Beetles		
Order: ODONATA	Dragonflies & Damselflies		
Order: MEGALOPTERA	Dobsonflies		
Order: LEPIDOPTERA	Moths		
Order: AMPHIPODA	Scuds		
Order: ISOPODA	Sowbugs		
Order: HEMIPTERA	True Flies		
Class: OLIGOCHAETA	Briste Worms		
Class: GASTROPODA	Snails		
Class: PELECYPODA	Clams		
Class:PLANARIAN	Flat Worms		
Class: Hirundinea	Leeches		
Other types (not listed)			
	Grand Total:		

Calculations	EPT Ratio	EPT to Chironomidae Ratio	Total # of taxa	EPT Family Richness (estimate)



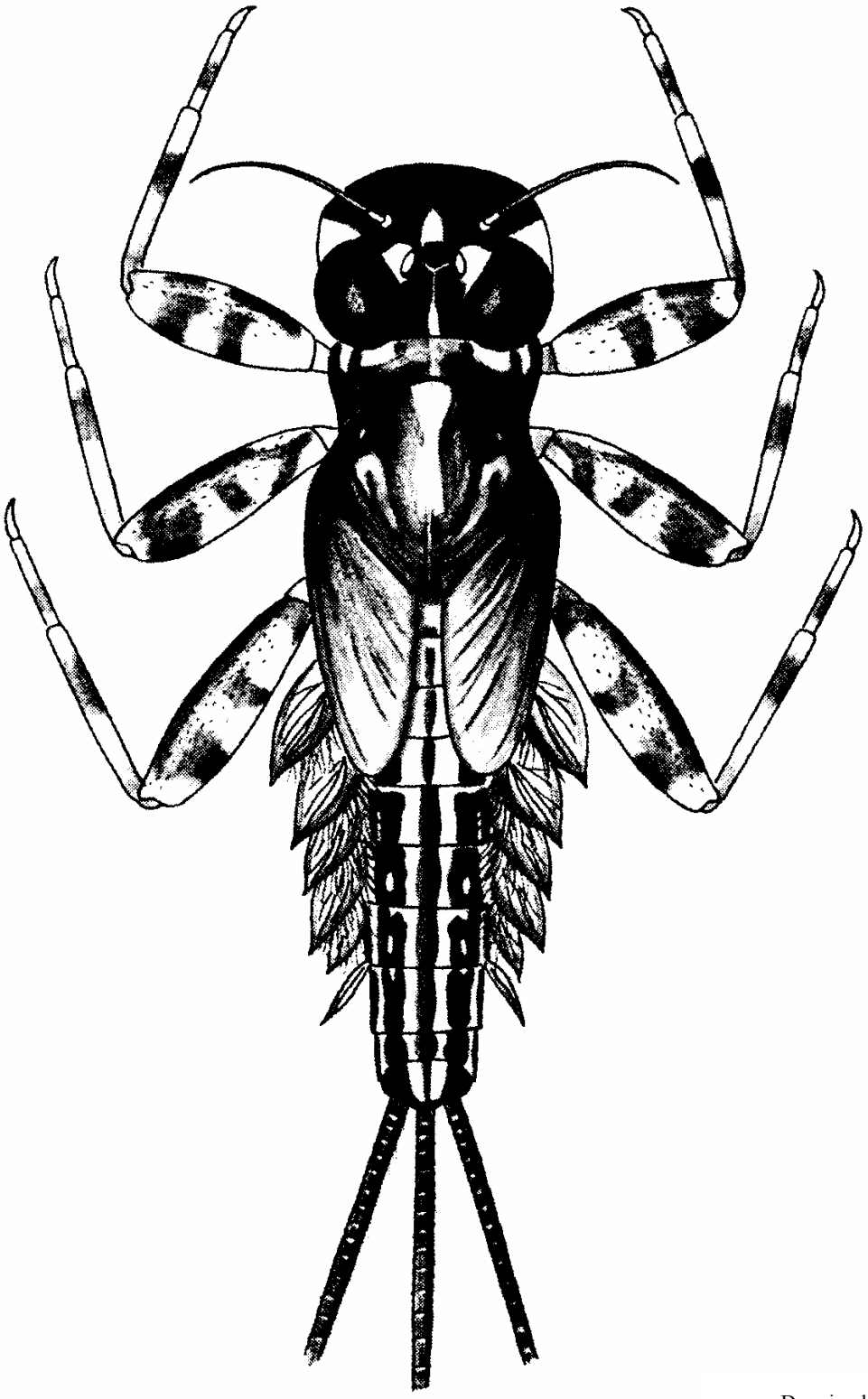
Cranefly
Order: Diptera
Family:
Tipulidae

Drawing by Arwin V. Provonsha in Aquatic Entomology by McCafferty



Drawing by Arwin V. Provonsha in Aquatic Entomology by McCafferty

Stonefly, Order: Plecopter, Family: Nemouridae



Drawing by Arwin V. Provonsha in Aquatic Entomology by McCafferty

Mayfly, Order: Epheroptera, Family: Heptageniidae