Toward an online digital teaching collection of aquatic macroinvertebrates using interactive, gigapixel technology (Ephemeroptera, Plecoptera, and Trichoptera)

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Beginner’s challenge in learning to ID insects is to eliminate everything but the correct association. Experts focus quickly on diagnostic features.
Most available tools are pictorial guides, flash cards, or dichotomous keys.

**WV Save Our Streams’ Benthic Macroinvertebrate Field Guide**

**What is an insect?** An insect is an invertebrate (an animal with no spine) that has three-pairs of legs (except Diptera) and three body divisions; the head is the location of the mouth, antenna and eyes; the thorax is the attachment site for the legs and wing pads; and the abdomen, which often has a variety of structures attached including filaments gills and tails. Gills are usually leaf-like, plate-like, or thin filaments. Tails can be long and thin, hairy, webbed or paddle-like. Most of the benthic macroinvertebrates you will encounter during stream surveys are aquatic larva or nymphs of insects. Most adult stages are not aquatic but beetles are the exception. The majority of the insects are described and illustrated on page one and the top of page two; non-insect group descriptions and illustrations begin on page two. Additional instructions are provided at the bottom of page two.

**Insect Groups**

**Mayflies**
(Order **Ephemeroptera**): Three-pairs of legs with a single hook at the end; three sometimes two tail filaments; gills attached to the abdomen.

**Stonflies**
(Order **Plecoptera**): Three-pairs of legs with two-hooks at the end; two tail filaments; no gills attached to the abdomen but some kinds may

**Case-building caddisflies**
(Order **Trichoptera**): Grub-like soft body and a hard head; Three-pairs of legs located on the upper third of the body; tail is small and usually
Identification Guide to Freshwater Macroinvertebrates

Jointed legs
- 10 legs or more
  - AMPHIPODA scud
  - ISOPODA sowbug
  - DECAPODA crayfish
- 8 legs
  - ARACHNIDA water mite

No jointed legs
- 6 jointed legs
  - MOLLUSCA – snail, clam
  - Non-segmented flat-worm
    - Head and/or fleshy protrusions
      - PLATYHELMINTHES planaria or flat worm
- Body enclosed in hard shell
  - Segmented worms
    - ANNELIDAE aquatic worm
    - HIRUDINEA leech
Our tool opens with a general overview that beginners like...
Clicking on a single family expands that information....
Clicking on a single genus opens the zoomable gigapixel image. Guitar pics identify characters diagnostic for Order, Family, and Genus.
Because the gigapixel image is 30 to 50 individual images stitched together on an axis, the screen becomes a powerful microscope. Zoom with touch screen, mouse, or +/- buttons.
Insert box shows how zoomed image fits into general habitus, position, and size.
Aquatic Macroinvertebrate Collection
An explorable resource for stream insect identification

Genus | EPHEMEROPTERA Heptageniidae maccaffertium

Maccaffertium
Diagnostic characters are available by clicking on thumbnails.
Program zooms to selected character, opens new information.
Pull down menu allows user to move to another genus or support tool.
Jump to caddisflies....
Jump to Glossosomatidae...
Glossosoma: Click “i” to open more information...
Mesonotal membrane and John Morse commentary
User can switch between dorsal, lateral, and ventral views by clicking...
Glossosoma ventral view
Thumbnail popup, diagnostic anal opening and information
Advantages:
Gestalt available from synoptic view
Responsive to level of inquiry
Different representational forms improve demonstration (video of gills moving)
Interview is more engaging than blocks of text.
Trials with Allegheny College’s *Creek Connections* program

Twenty-one 9th through 11th graders of mixed gender participated in the embedded assessment activity. Of these, 71% had done some sort of insect identification before. Students visit different stations and use different tools to ID specimens.
Table 1: Accuracy of Insect Identification By Resource

<table>
<thead>
<tr>
<th></th>
<th>Dichotomous Key</th>
<th>Flashcards</th>
<th>Digital Teaching Collection</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>50%</td>
<td>100%</td>
<td>98%</td>
<td>.000*</td>
</tr>
<tr>
<td>Family</td>
<td>17%</td>
<td>38%</td>
<td>86%</td>
<td>.000*</td>
</tr>
<tr>
<td>Genus</td>
<td>N/A**</td>
<td>38%</td>
<td>87%</td>
<td>.000*</td>
</tr>
</tbody>
</table>

Students reported liking Digital Teaching Collection for the detailed images (52%), ease and efficiency of use (29%), and the way in which the insects were organized within the online interface (29%):

“The digital one is really nice because of the touch screen and how easy it is to use. The pictures are also extremely good, so it is easy to compare the real specimen and the picture.”