Activities and Additional Information

Notes on Pond Invertebrates

Adaptations to insects living in water concern: respiration; movement; getting food; anchorage, among others.

Adaptations to Breathing:

1. **a spiracle tube for piercing the surface film** – example = mosquito larvae – have respiratory tube or siphon, to break surface tension of water – mosquito larvae can get enough oxygen this way to allow submerging for 10 minutes – when taking in oxygen, to remain at surface mosquito larvae have hydrofuge hairs that spread out on the film of surface water
2. **a device for carrying air on the outside of the body** – insect must first come to surface and break the film – water boatmen do this with their head; giant water bugs with flaps at end of abdomen; some beetles with unwettable clubs of antennae or with tip of abdomen – air then drawn in through any spiracle (tube-like opening) and channeled to spaces under the wings or on belly side (ventral side) of body where held in place by minute hydrofuge hairs coating body with silver sheen – acts as physical lungs or air gill – oxygen exchanged between this "physical lung" and body, going from highest concentration to lowest, similarly, can also absorb oxygen from water (higher concentration) into physical lung (also called plastron) then into insect's body – allows some insects to stay below for up to 20 minutes, some for hours, or weeks
3. **tracheal gills** – these are thin-walled cutaneous outgrowths that contain many air-filled trachea – oxygen diffuses in and CO_2 diffuses out – gills are present on mayflies on their abdomen and they also have tail gills (this gives some indication of them living at the bottom where oxygen levels can be low) stoneflies have tracheal gills under their appendages on their thorax – dragonfly and damselfly nymphs, and caddis larvae have rows of tracheal gills in their anal area (lining of their rectum)
4. **blood gills** – these are thin-walled outgrowths of the larval body that are continuous with the blood cavity – occurs in some caddis larvae – insect blood contains haemoglobin for carrying oxygen – insects with blood gills usually live in waters of low oxygen
5. **chewing or piercing plants for oxygen in their tissues** – some insect larvae have a body part for piercing into plants and taking the oxygen from the tissues

Adaptations for moving in water:

1. streamlined bodies
2. body may be keeled, and boat shaped, may have smooth slippery outer
3. antennae sometimes folded back into grooves on sides of head
4. 1 or more pairs of legs flattened and fringed with long hairs
5. hind legs of many beetles have a segment expanded and paddle-like
6. jet-propulsion – dragonfly and damselfly larvae – suck in water through anal opening and shoot it out

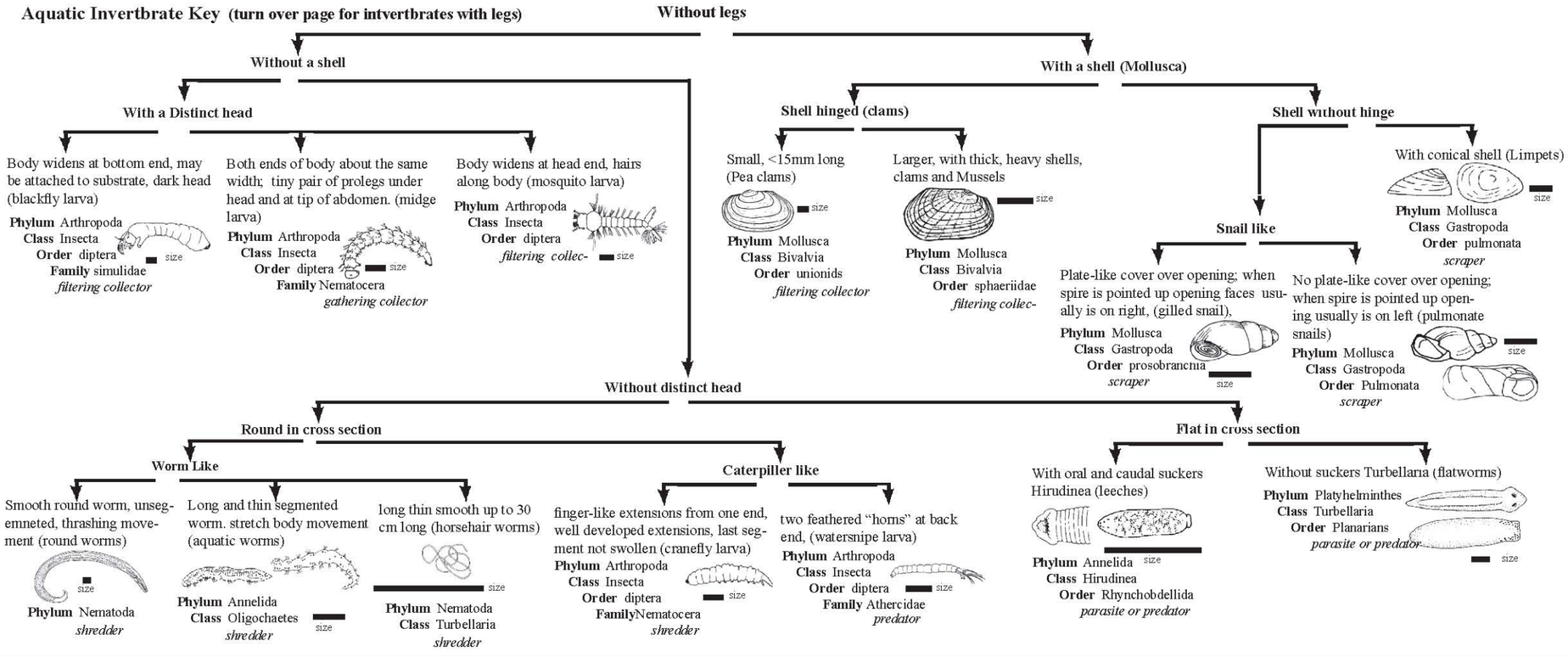
Adaptations for Anchorage:

1. air-filled trachea mean insects would have tendency to float to surface – so many have claws to cling to vegetation
2. some have flattened bodies
3. caddis fly larvae are held down by weight of cases – to make their case they first spin a silken tube, in this they set their building material – if using vegetation many of the bits will have been especially cut to size and laid end to end or parallel for woven pattern or spiral – for most species they make same kind of case from same type of materials
4. more adaptations for fast moving water

Adaptations for Getting Food:

1. water tiger (larvae of predaceous diving beetle) attack insects, tadpoles, snails, etc – use sharp dagger-like jaws to grasp victim, then inject juices into victim that digest its body and water tiger sucks up meal
2. dragonfly and damselfly nymphs are voracious predators, feeding on insects, sometimes tadpoles and small fish – they have a large lower lip (labium) that flips out instantaneously to catch its prey, grapping hold with tiny teeth along the lip
3. mayfly nymphs feed on diatoms (phytoplankton) and other microscopic plant organisms, or chew tissues of higher plants
4. caddis fly larvae are omnivorous, eating diatoms, algae, small bits of plant material, but also eat small crustaceans (gammarus or scuds), insects and worms

Aquatic Invertebrates Dichotomous Key (compiled by Robert Sharp)



Organisms found in good quality water, Sensitive to pollution.

Taxa (groups) Counts	
Order Plecoptera (Stonefly)	
Order Trichoptera (Caddisfly)	
Order Coleoptera (Water Penny)	
Order Coleoptera (Riffle Beetle)	
Order Ephemeroptera (Mayfly)	
Class Gastropoda, family Prosobranchs (Gilled Snail)	

# of Taxa (groups) _____
Water Quality Index number x 3 _____

Organisms found in moderate quality water, Somewhat tolerant to pollution.

Taxa (groups) Counts	
Order Decapoda, (Crayfish)	
Order Isopoda (Sowbug:)	
Order Amphipoda (Scud:)	
Order Megaloptera, Family Oialidae (Alderfly larva):	
Order Megaloptera, Family Corydalidae (Fishfly larva)	
Order Odonata, Suborder Zygoptera (Damselfly: larva)	
Order Diptera, Family Athercidae (Watersnipe Larva)	
Order Diptera, Suborder Nematocera (Crane Fly)	
Order Coleoptera (Beetle Larva)	
Order Odonata Suborder Anisoptera (DragonFly larva)	

# of Taxa (groups) _____
Water Quality Index number x 2 _____

Organisms found in poor quality water, Tolerant to pollution.

Taxa (groups) Counts	
Class Oligochaeta (Aquatic Worm)	
Order Diptera, Suborder Nematocera (Midge Larva)	
Order Diptera, Family Simulidae,(Blackfly Larva)	
Order Hirudinea (Leech)	
Class Gastropod, Order Pulmonata (Pouch Snail and Pond Snails	
Class Turbellaria (Planarian)	
Order Hydracarina (Water Mite:)	
Order Hemiptera (True Bug Adult)	
Phylum Nematoda	

# of Taxa (groups) _____
Water Quality Index number x 1 _____

Total Water Quality Index (sum of three categories) ___

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

Correlating invertebrate data with sources of pollution

Study characteristics	Stream
high diversity, high counts of pollution sensitive invertbrates	no problems, good water quality

Study characteristics	Stream condition
low diversity, high counts, many scrapers and collectors	organic enrichment/pollution or lots of algal growth resulting from nutrient enrichment

Study characteristics	Stream condi-
high diversity and low counts, or, no insects but stream appears clean	toxic pollution (eg chlorine, acids, heavy metals, pesticides) or, another sever problem of unknown origin

Study characteristics	Stream condition
low diversity and low counts of all types of invertbrates	physical problems (eg downstream of dam, sedimentation from errosion) , or, sometimes streams are unproductive for natural reasons (glacier feed streams, spring fed streams)

Aquatic Invertbrate Key (turn over page for intvertbrates without legs)

With Legs

With 6 legs

No wings or small and do not cover abdomen

Round flat body

spiderlike larval (water-mites)
Phylum Arthropoda
Class Arachnida
Order Hydrachnidia
predator
size

body oval and flat; head and legs concealed beneath (water penny)
Phylum Arthropoda
Class Insecta
Order Coleoptera
scraper
size

Elongated Body

With long, segmented "tails.

With 2 tarsal -claws and 2 "tails" often with thoraoi gills.(stonefly larvae)
Phylum Arthropoda
Class Insecta
Order Plecoptera
predator
size

With 1 tarsal claw, 3 (occasionally 2) "tails", and with lateral abdominal gills. (mayfly larvae)
Phylum Arthropoda
Class Insecta
Order Ephemeroptera
predator
size

Without long segmented tails

No fan like tails

two or three fan like tails 3 oar-shaped tails; no gills along abdomen (damselfly nymph)
Phylum Arthropoda
Class Insecta
Order Odonata
predator
size

long thin abdomen

fat abdomenlarge eyes, mask-like lower lip onfly nymph)
size
Phylum Arthropoda
Class Insecta
Order Odonata
predator

no body houses

fixed or portable houses made of sand or plants, terminal abdominal prolegs, usually with fingerlike abdominal gills, (caddis flies)
Phylum Arthropoda
Class Insecta
Order Trichoptera
predator
size
house types

no lateral filaments along abdomen body is hardened and stiff, abdomen with hooks and filaments (riffle beetle larva)
Phylum Arthropoda
Class Insecta
Order Coleoptera
gathering collector
size

lateral filaments along abdomen

fluffy or branched gill tufts under abdomen (dobson fly larva)
Phylum Arthropoda
Class Insecta
Order Megaloptera
predator
size

no branched gills under abdomen

abdomen does not end in single, unforked, long hair-like tail

abdomen ends in a pair of prolegs, each with 2 hooks (fishfly larva)
Phylum Arthropoda
Class Insecta
Order Megaloptera
predator
size

abdomen does not ends in a pair of prolegs, (aquatic beetle larva)
Phylum Arthropoda
Class Insecta
Order Coleopter
predator
size

abdomen ends in single, unforked, long hair-like tail (alderfly larva)
Phylum Arthropoda
Class Insecta
Order Megaloptera
predator
size

With more than 6 legs

With 8 legs adult (water-mites)
Phylum Arthropoda
Class Arachnida
Order Hydrachnidia
predator
size

More than 8 legs

long flat body with more than 12 legs, crawls slowly (aquatic sowbug)
Phylum Arthropoda
Class Crustacea
Order Isopoda
predator
size

Large, armed with a pair of pincers (crayfish)
Phylum Arthropoda
Class Crustacea
Order Decapoda
predator
size

Small, laterally flattened,curved body (scuds)
Phylum Arththo
Class Crustacea
Order amphipoda
predator
size

With wings and leathery forewings covering abdo-

short legs, swims or dives quickly, with biting moutl parts (adult beetle)
Phylum Arthropoda
Class Insecta
Order Coleoptera
predator
size

Not short legs

beetle-like, crawls slowly on bottom (riffle beetle adult)
Phylum Arthropoda
Class Insecta
Order Coleoptera
scraper
size

longer legs, swims quickly with sucking mouthparts forming a jointed beak (true bug adult)
Phylum Arthropoda
Class Insecta
Order Hemiptera
swim on back - *predator*
swims on front, - *shredder*
size