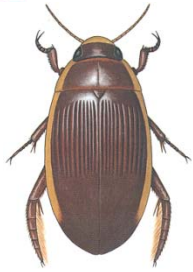


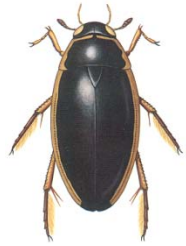


Aquatic Critters

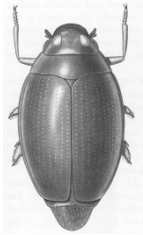
(pictures not to scale)



↑ **predaceous diving beetle**
 - thread-like antennae longer than the head
 - surface for air with tip of abdomen first
 - row back legs together

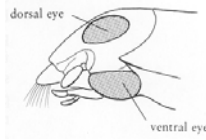


↑ **water scavenger beetle**
 - short, clubbed antenna
 - surface head first
 - swim by moving hind legs alternately



↑ **whirligig beetle larva**
 (fairly common look for beetle larvae)

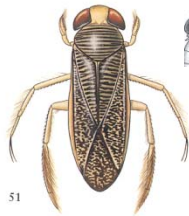
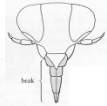
↑ **whirligig beetle adult**
 - looks like it has 4 eyes! (see above)



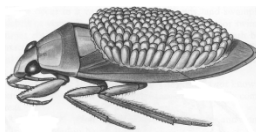
↑ **water penny** →
 (type of beetle larva found under rocks in streams)



↑ **backswimmer (& head)**
 - swims on back
 - pointy, longer beak
 - predator



↑ **water boatman (& head)**
 - swims on front
 - rounded, smaller beak
 - herbivore



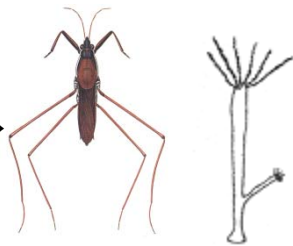
↑ **giant water bug**
 (toe biter) female glues eggs to back of male



↑ **caddisfly adult** & larva →



↑ **water strider** →



↑ **hydra**

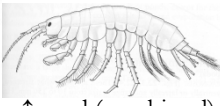
↓ **4 small crustaceans** ↓



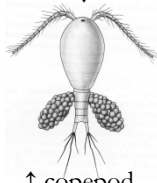
↑ **rotifer**



↑ **daphnia (water flea)**



↑ **scud (amphipod)**



↑ **copepod**



↑ **ostracod (seed shrimp)**

prepared by Gwen Heistand for ACR Education



Aquatic Critters

(pictures not to scale)



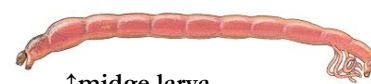
↑ **mayfly adult**



← **mayfly naiad**
 - 3 "tails"
 - abdominal gills



↑ **stonefly naiad & adult** ↑
 - 2 "tails"
 - thoracic gills
 - find in streams



↑ **midge larva (bloodworm)**



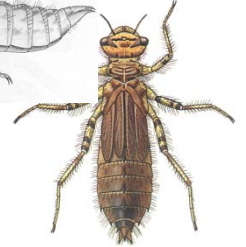
↑ **midge adult**



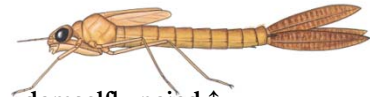
↑ **dragonfly naiad** →



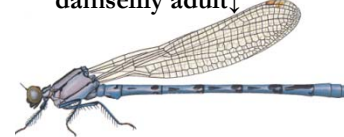
↓ **dragonfly adult**



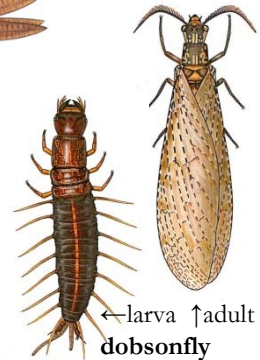
No apparent gills (breathes thru butt)
 Lower jaw to grab prey



↑ **damselfly naiad** ↑
 - 3 leaf-like posterior gills
 - lower jaw to grab prey



↓ **damselfly adult**



← **larva** ↑ **adult dobsonfly**



↑ **mosquito larva (wiggler)**



↑ **mosquito pupa**



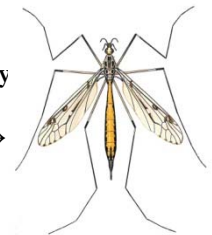
← **mosquito adult** (males with feather antennae)



↑ **phantom midge larva** ↑
 - translucent with silvery buoyancy floats

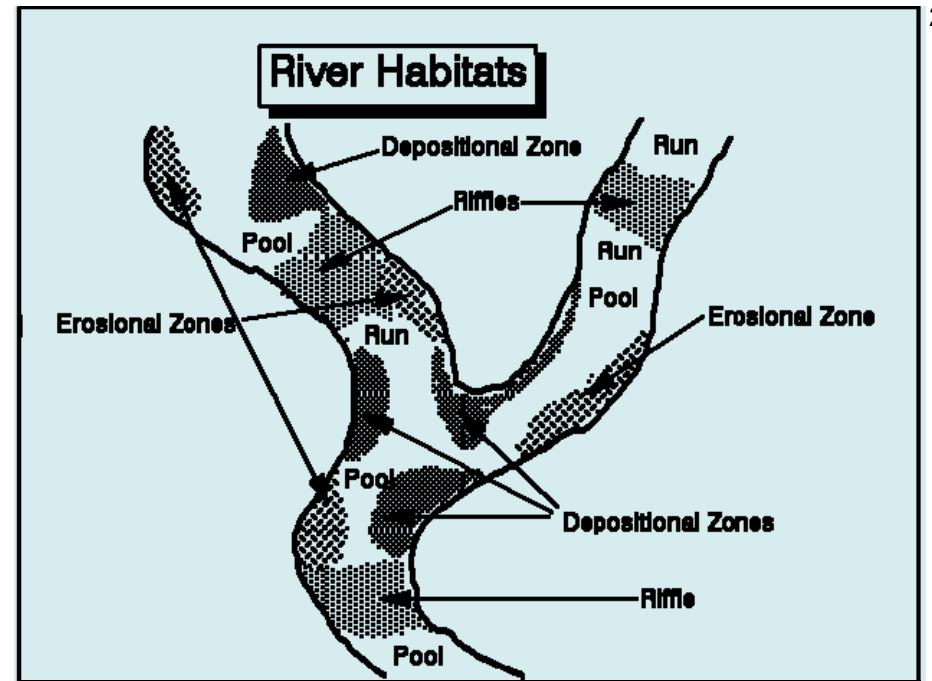
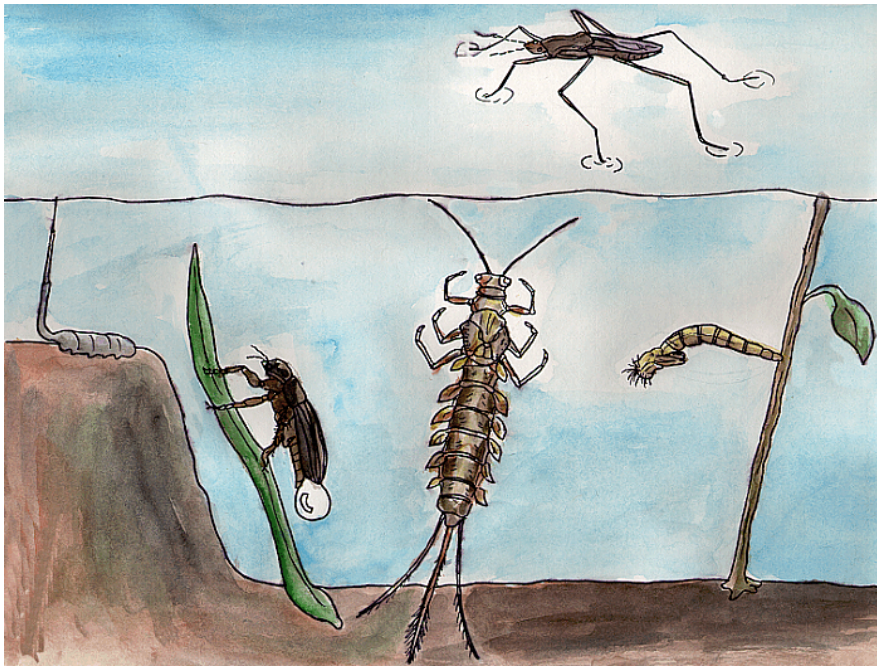


← **crane fly larva** adult →



References: Aquatic Entomology by W. Patrick McCafferty
 Guide to Microlife by Kenneth G. Rainis and Bruce J. Russel

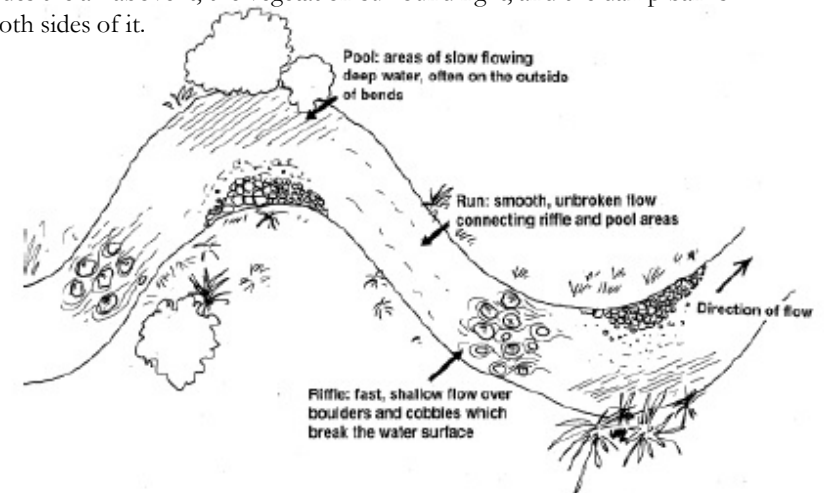
How do Aquatic Critters Get Their Air?



Creeks are a **lotic** (flowing) systems as opposed to **lentic** (standing, i.e, pond) system. Look for ...

1. **RIFFLES:** clear water flowing over shallow gravel separated by deeper pools (riffles contain more oxygen than pools; critters need to be able to cling i.e., caddisfly, stonefly mayfly larvae)
2. **POOLS** that collect organic debris
3. **RUNS:** Close to any pool or riffle is likely to be a run which is a main body of water that runs smoothly downstream. Fishes too small to compete for pools often end up in runs, as well as various schooling minnows,

There is also the area immediately around the stream: the stream ecosystem includes the air above it, the vegetation surrounding it, and the damp banks on both sides of it.



BREATHING IN AN AQUATIC ENVIRONMENT

AERONEUSTIC (use atmospheric air)		HYDRONEUSTIC (use oxygen in water)		ENDOPHYTIC
continual contact with air; tube breathers; respiratory horns, siphone breathers	periodic contact with air; air storage breathers, underwing chambers, plastrons, dense coverings of unwettable hairs	cutaneous uptake; through cuticle; use gills	spiracular uptake; keep layer of air over entry to respiratory system	pierce plants and get oxygen from them
most aquatic fly larvae (midges, mosquitoes, rat-tailed maggots); fly pupae	many adult water beetles; some true bugs	larvae of mayflies, damselflies, dragonflies, stoneflies, newts	adult riffle beetles, some creeping water bugs	aquatic leaf beetle larvae; pupae of 2 mosquito species and some shore flies

SOME AQUATIC HABITATS

Plankton	Nekton	Benthos	Neuston	Aerial
(at the mercy of the currents)	(propel themselves through the water)	(on the bottom)	(at the air-water interface; use surface film)	(organisms dependent on water)
copepods, daphnia	fish, newts, diving beetles	dragonfly / damselfly nymphs, nematodes, ostracods, snails,	waterstriders, rifflebugs, whirligig beetles, some spiders	adult dragonflies, adult mosquitoes, adult stoneflies

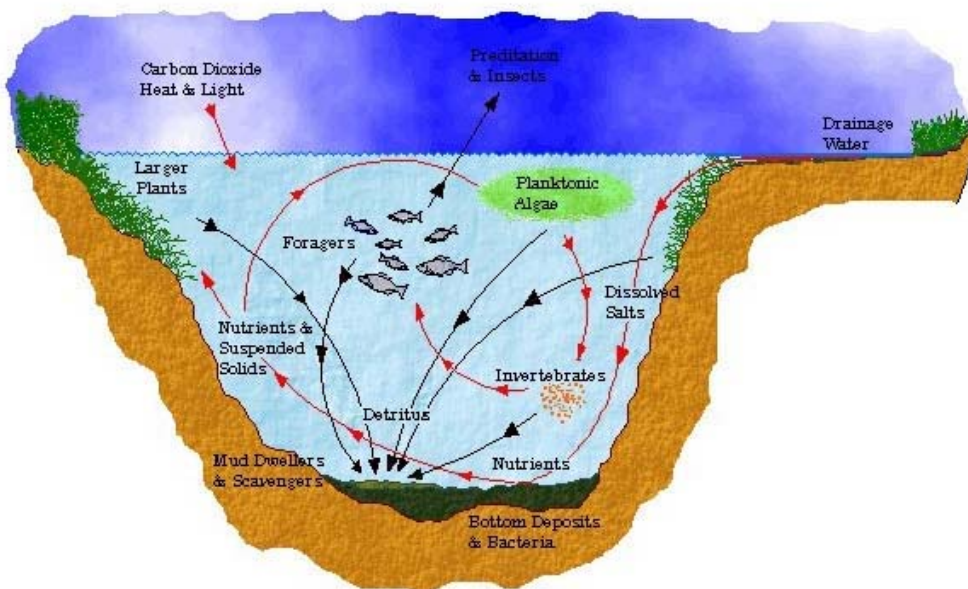
Aufwuchs is a stream ecology term to describe the microscopic community attached to rocks, plants, submerged logs, etc.

With the exception of very slow, deep stretches of rivers or streams, plankton are not that prevalent. Benthic invertebrates, especially larval insects, dominate the benthic fauna.



Ponds and Pools

Slow to still water. Often find smaller plankton. Larger pools in streams can contain similar critters.



Shredders, such as stoneflies (plecoptera) feed on plant material and some animal material, which is generally dead, and break it into smaller particles through their feeding and digestive process.



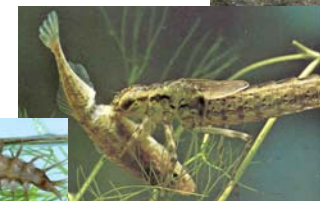
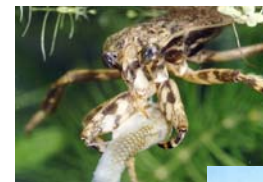
Collectors/Filterers, such as caddisflies (trichoptera) and blackflies (diptera), feed on this fine particle material which they filter from the water.



Scrapers/Grazers, such as snails and some beetles, feed on algae and other plant material living on rocks and on plant surfaces.



Predators, such as dobsonflies (magaloptera), dragonflies & damselflies (odonata), and giant water bugs (hemiptera) feed on other macroinvertebrates.



Individual species may be generalists, and fit into more than one of these groups (as opposed to specialists).

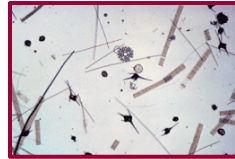
Plankton (at the mercy of the currents)



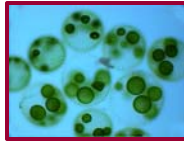
copepods



daphnia



diatoms



volvox

Zooplankton

Phytoplankton

Neuston (at the air-water interface)



whirligig beetle



backswimmer



water strider

Nekton (swimmers)



sculpin



newt



California roach

Benthos (dwelling on the bottom)

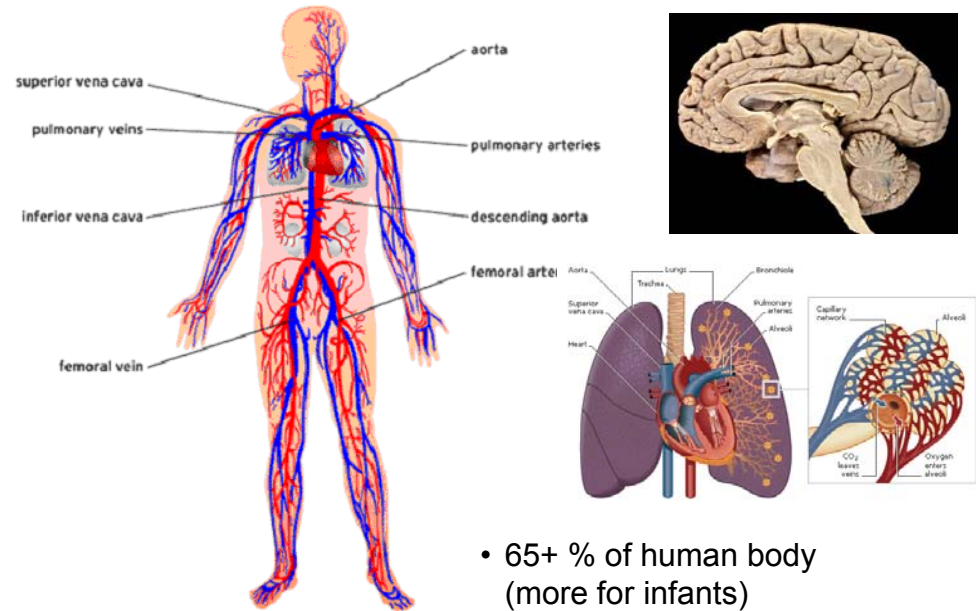


black fly larvae



dragonfly larva

What Percentage of *Us* is Water?



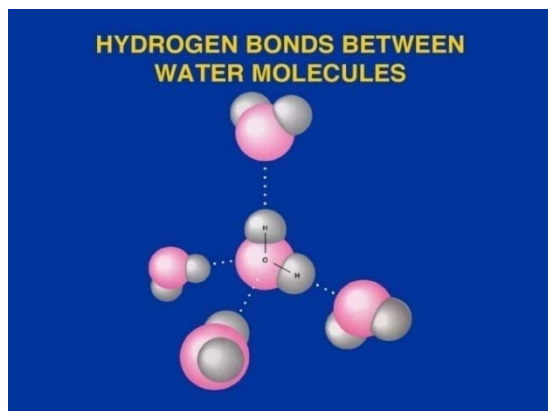
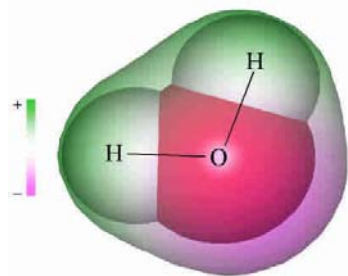
- 65+ % of human body (more for infants)
- 70% of brain
- 82% of blood
- 90% of lungs

What Percentage of *the Earth's Surface* is Water?



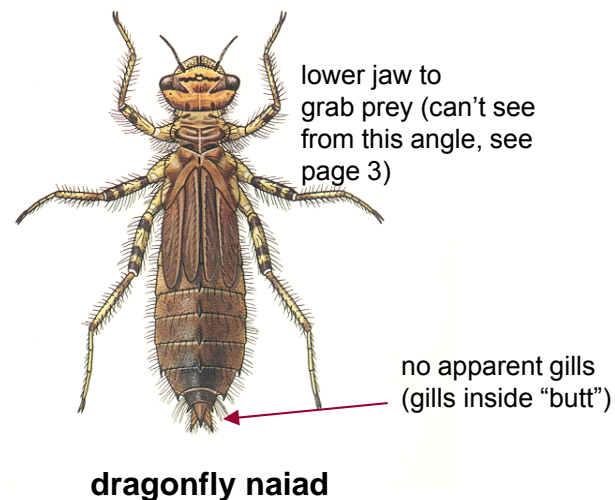
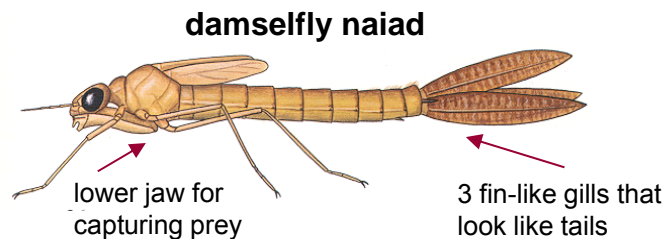
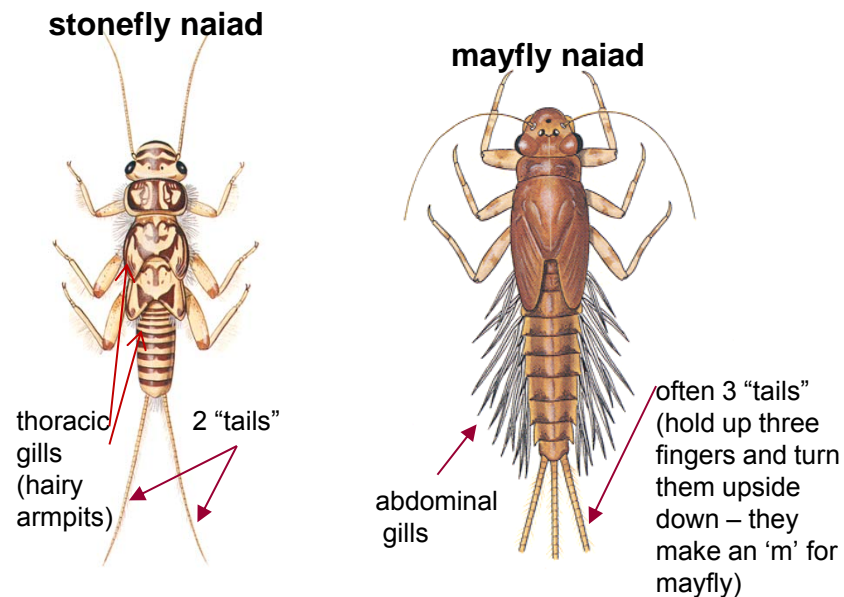
- 71% of earth's surface is water
- 1% of this water is fresh & drinkable
- Most of this water is tied up in the atmosphere and underground

Some Cool Things About Water



- Water molecules are strongly attracted to each other (hydrogen bonding).** This allows for **cohesion** and **adhesion!** (try putting a drop of water and a drop of alcohol on a flat glass plate ... and look at what happens ... the water will mound up and the edges will be clear and distinct ... the alcohol will spread out ... and also evaporate really quickly).
 - cohesion:** stick to itself;
 - adhesion:** stick to something else)
 - cohesion + adhesion = capillarity** (the tendency of a fluid to rise up a narrow tube)
- Water holds heat.** Why is this important? Don't have rapid changes in temperatures.
- Water is a universal solvent:** most things dissolve in water (oil & gasoline don't.) What does this mean for animals??? **OXYGEN!!!**
 - dissolved oxygen** is really important for animals that breathe through gills or a cuticle
 - dissolved CO₂** for photosynthesis.
 - dissolved calcium** for cell walls, cell growth, exoskeletons
- Water density increases as it cools until it reaches 39.2 degrees F (4 degrees C).** Then the silly stuff gets less dense ... why **ice cubes float**
- Water is transparent.** So WHAT? ...
 - Sunlight penetrates water.** (needed for photosynthesis)
 - Sometimes harder to hide** ... and at the same time easier to find food ... there are tradeoffs.

Aquatic Critters	Pg #
Comparison of larval insects	1
Mayflies (Ephemeroptera)	2
Dragonflies & Damselflies (Odonata)	
Dragonflies	3
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Waterboatmen	7
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How Many Drops of Water Fit on a Penny?

Materials: 6 pennies and 6 eyedroppers in a plastic baggie with a vial of water



Activity

Have each kid take a penny. And an eye dropper Before you start, have them guess how many drops of water they can fit on a penny before it spills off.

This exercise helps demonstrate water's hydrogen bonds. The cohesive (how water molecules stick to each other) and adhesive (how water molecules stick to something else) properties of water are what enable water to stick to the penny and mound up. These properties (cohesion + adhesion) are what contribute to water's capillarity (the ability of a fluid to rise up a narrow tube). Ask kids what some examples of how these properties are used in nature might be (just a few examples: water in blood vessels, water retained in "pores" in the soil, the ability of a mosquito to "suck" blood, the reason water striders can skate on the surface of the water)

An Apple as the World

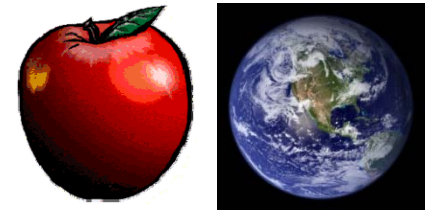
Objective

To get the children thinking about how much of the earth is habitable, how much water is available for drinking, how much land can grow crops, etc.

Materials: Apple, Knife

Activity

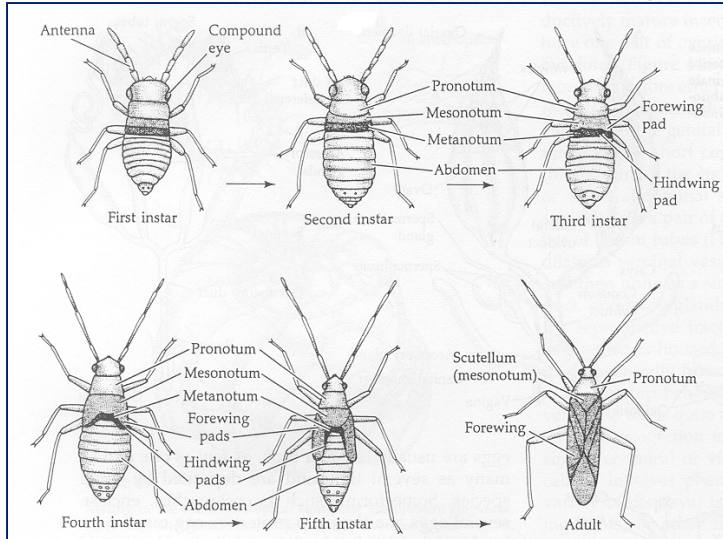
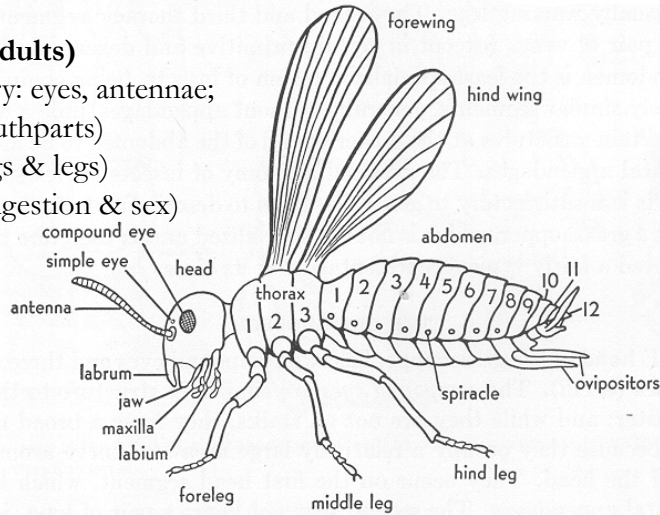
- Cut the apple into quarters.
 - $\frac{3}{4}$ of the Earth's surface is water
 - $\frac{1}{4}$ of the Earth's surface is land
- Cut the $\frac{1}{4}$ representing land in half.
 - $\frac{1}{2}$ of the land, or $\frac{1}{8}$ the total Earth's surface is habitable. The rest of the land is deserts, mountains, frozen ice caps, and other places people cannot live.
- Take the piece that represents the habitable land, and cut it into four sections.
 - $\frac{1}{4}$ of the Earth's habitable land, or $\frac{1}{32}$ of the Earth's is where ALL of the Earth's food comes from. As you are asking the children what would happen if this part of the Earth were damaged or destroyed, you can eat that piece of the apple for effect.
- Take a small shaving off one of the slices that represents the water of the world.
 - Less than 1% of the Earth's water is fresh and drinkable. Most of this water is tied up in the atmosphere (clouds) and underground. As you ask the children what would happen if the water was polluted or waster, eat the shaving. This strategy can be a lead-in to an open-ended discussion about taking care of our resources.



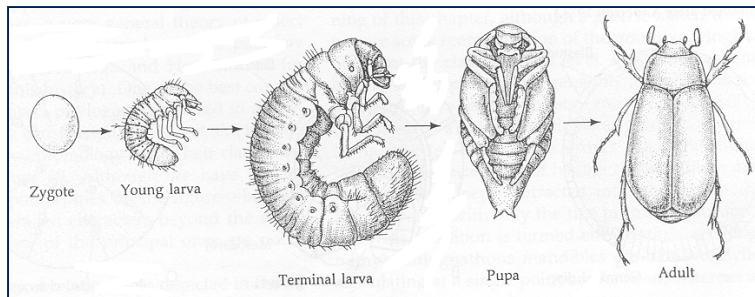
Insect Review

3 body parts (adults)

1. head (sensory: eyes, antennae; feeding: mouthparts)
2. thorax (wings & legs)
3. abdomen (digestion & sex)



example of incomplete or gradual metamorphosis



example of complete metamorphosis

Mayflies (Ephemeroptera)



naiads:

- abdominal gills
- 3 “tails” or cerci
- benthic critters (bottom dwelling)
- Larvae can be swimmers, sprawlers, clingers, burrowers, & drifters. There are many kind of damselfly nymph “flies” that are used in fly fishing.
- **only insect where there is a fully winged stage (subimago) prior to final adult molt!**
- naiads are **detritivores** or **herbivores**

adults:

- many **veins** in wings and long cerci
- **don't eat** (only possess nonfunctional remnants of larval mouthparts),
- **seldom live for more than a day** or two (some may live up to a month) Their purpose is to mate, then they die. This is why we see “**hatches**” – if you only live for a day and you need to find a mate – you all need to “hatch” at the same time!

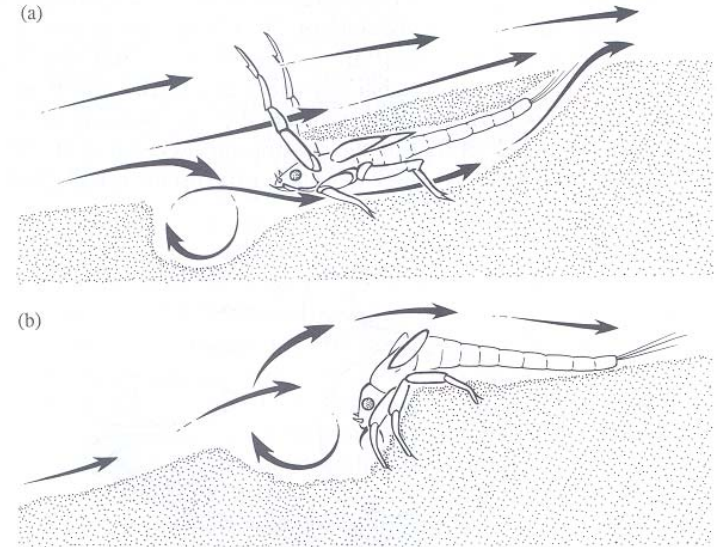


FIGURE 10.9. Two mayfly larvae that take advantage of the upstream (center) part of a horseshoe vortex. *Ametropus* (a) makes a pit for its vortex, which then traps edible suspended particles. *Pseudiron* (b) arranges itself so the vortex digs the pit while it eats any excavated prey. It moves slowly backward (downstream) so excavation proceeds continuously.

Dragonflies (Odonata)

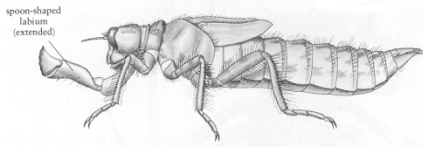


Figure 8.23. *Cordulegaster* larva

larval jaw extended (side view)



larval jaw extended (from above)



dragonfly naiad (larva)



adult dragonfly emerging

larvae (naiads)

- fearsome **predator** (eats insects, small fish, tadpoles)
- take **oxygen** from water; **draw in through end of abdomen** and then shoot it out (this is a very exciting thing for the kids to see!!!)
- moves via **jet propulsion** by shooting water out of gills at end of abdomen (looks like it's shooting water out of "butt")
- **extensible jaw** like damselfly naiad that it is thrust out to capture prey (death by lower lip!)
- has **large eyes** like adult phase
- final instar crawls out of water and adult emerges

adults

- eats mosquitoes, caddisflies & other flying insects
- use legs like basket to capture prey on wing
- powerful flier
- wings spread out to sides of body when at rest
- large compound eyes that meet in center



adult female ovipositing

Fish: Sculpin *Cottus asper*



Small fish (rarely larger than 4 inches)

- **adaptable** to environments ranging from fresh to saltwater, and from small cool stream to large warm rivers and lakes
- **variety of forms:** coastal, valley, Clear Lake
- **water quality** seems to be limiting factor with respect to spread of this species
- use a **variety of habitats** but require good cover or overhanging vegetation
- spend most of the day sedentarily hiding; become active at night
- reach **sexual maturity** after 2, 3, or 4 years: move to a suitable place in freshwater to spawn; hide eggs under loose rocks
- **spawning occurs** between February and June
- Each female may lay up to 11,000 eggs & males can mate with more than one female – so nests may have upwards of 30,000 eggs.
- **male chase females away and guards fertilized eggs** until they hatch
- larvae emerge and are quickly washed downstream to an estuary or deep slow pool
- as larvae develop into juveniles they move to productive feeding areas, often times moving upstream a considerable distance (movement of fish is often limited by man-made barriers or diversions)
- **feed on** benthic invertebrates, insects, salmonid eggs small fish, frogs

Fish: California Roach *Lavinia symmetricus*



native to western North America and abundant in the intermittent streams throughout central California;

Sole member of its genus



- relatively **chunky, largish head, large eyes, small mouth** oriented downwards, darker grayish-bluish above & dull silver underneath, red-orange patches appear on chin, operculum, and at bases of pectoral, pelvic, and anal fins during breeding season, **small fish** - maximum known 11 cm
- **bottom feeder (mostly):** filamentous algae is main food, followed by aquatic insects and crustaceans; will also eat insects and crustaceans at the surface
- **Spawning** occurs March – June; fish move into shallow, flowing water, over bottoms covered with small rocks, and form up into schools. Females lay a few eggs at a time, eventually putting down from 250 to 900 eggs each. Eggs are adhesive & laid in crevices where males fertilize them. Fry continue to dwell in the crevices until they are strong enough to swim actively.
- Seem to be **resilient** and take advantage of the intermittent waters of central California under conditions too difficult for other fishes. As streams dry up in summer, roaches accumulate in pools in large numbers.

Damselflies (Odonata)



naiads

- fearsome **predators**, eating other aquatic insects and wee beasts
- **extendable jaw** that **snatches prey** in lightning quick movement
- oxygen taken in through **leaf-like gills** at end of abdomen
- **swims by moving body back and forth**
- eats huge numbers of mosquito larvae

adults

- wings folded back over the body when at rest (there are exceptions) (dragonfly wings held out)
- two pairs of wings
- eyes bulge to side (dragonfly eyes meet in center)



Damselfly Emergence

1. damselfly larvae **climbs out of the water** for the first time
2. **pulls itself** out of its **larval exoskeleton**
3. **four little protrusions** on the back of the damselfly will **become** the four **wings**. Notice length of abdomen ... It has begun to expand so that the damselfly is already bigger than its shed exoskeleton
4. a few minutes later and wings have changed from short stubs to longer wings. Notice how the abdomen is considerably shorter than the wings
5. Notice how the abdomen is now much longer than the wings. The damselfly is ready to fly away.

Stoneflies (Plecoptera)



naiads

- **thoracic gills** (gills on part of body where legs are ... many stonefly naiads look like they have hairy armpits)
- has **two long cerci (tails)**
- **eat** dead plant material and microscopic organisms
- are **not tolerant to low levels of dissolved oxygen** and therefore prefer cold, swift-moving streams
- streamlined, flattened bodies of stonefly nymphs enable them to **move** about the rocky streambed **in rapid currents**
- used as **bio-indicators** of stream health “lichens of the streams”

adults

- usually do not eat
- weak fliers
- squared off “shoulders” (wings extend beyond abdomen and they look a little like they’re wearing shoulder pads)
- short-lived (2-3 weeks)
- in some species males drum abdomen against hard surface to attract females



Fish: Steelhead *Oncorhynchus mykiss*

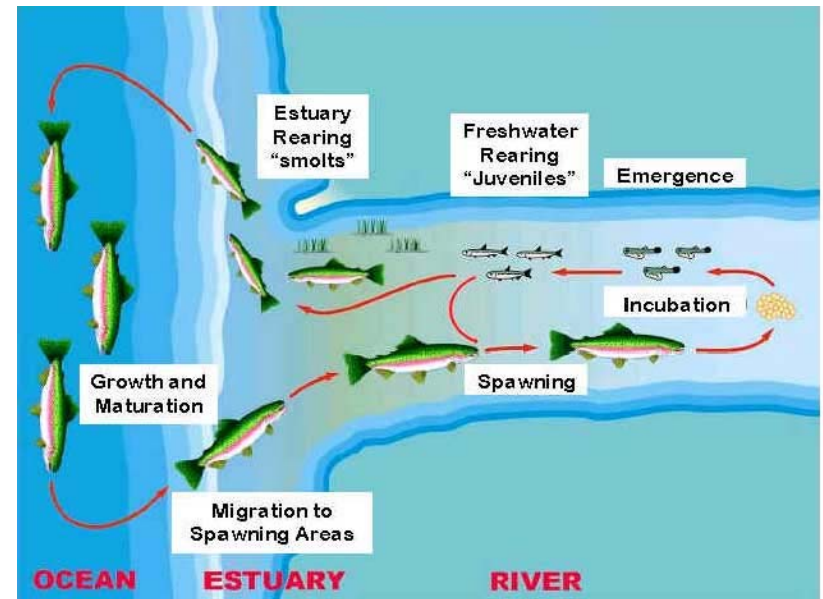


Names include: rainbow trout, half-pounder, salmon trout.
Steelhead and rainbow trout are the same species, but steelhead go to sea and rainbow trout don't.

Spawn in the spring, generally preferring fast water in small-to-large mainstem rivers, and medium-to-large tributaries. Steelhead may venture as far inland as 1000 miles to spawn, however, most are found nearer the ocean waters.

Steelhead fry emerge from the gravel in summer and generally rear for two or three years in freshwater, occasionally one or four years, depending on the productivity of the stream. Streams high in the mountains and those in northern climates are generally less productive.

Females usually produce from 200-12,000 eggs which hatch in 50 days (at 50° F).



Steelhead trout life-cycle.

Fish: Stickleback



↑female ↓male



Male prepares nest by sucking up sand or mud and depositing it at a distance; glues down fragments of weed and algae with mucous secreted by kidneys; after dome-shaped structure is completed, he forces himself through to make sure female will be able to penetrate the nest. (he'll attack anything that's colored red)

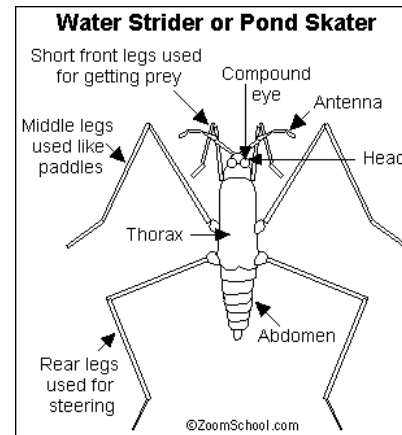


Sticklebacks have an **interesting courtship**: **male zags** toward female then turns away; if she's ready **she remains in a heads-up position** near the surface and turns to watch male; **male repeats** approach **until female follows** him down to nest where he will point out the entrance with his snout while turning his back partly towards her. Sometimes **female is not quite ready to spawn**; **male nips her flank**. If female is satisfied she'll wriggle into tunnel and male puts his snout against her projected tail and quivers violently. When female raises her tail, between 50 and 100 eggs are extruded and female leaves. Male goes into nest and releases sperm. Several females may spawn in same nest.

Male takes care of eggs: fanning the nest pushing a current of oxygenated water over the eggs.

After 5 days, eyes, beating heart, and tail are fully formed. Male teases nest apart after about 9 days and keeps watching young. Any stray will be picked up in males mouth and spat back in the nest. At 10 days, yolk sacks are used up and young rush to surface to fill their swim bladders.

True Bugs (Hemiptera) Water Striders (Gerridae)



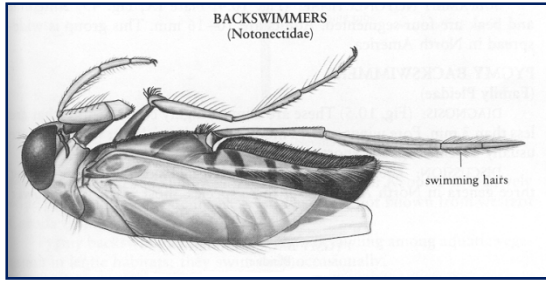
- **water striders are true bugs**: look for **characteristic “x”** on back and **piercing-sucking mouthparts**.
- **legs have feathery tips** (non-wettable hairs); allowing them to **skate across the surface using** the surface tension (neustonic critter; living in the air-water interface)
- **usually wingless**
- look for **shadows of water striders** on the bottom of the stream, and it will look like they have big paddle feet.
- have **tiny claws** set back from the front legs so that they don't break the surface film; use these to **handle captured insects**.
- **use the surface of the water, much as a spider uses its web**, to catch prey by sensing vibrations in the surface film.

Things to do with water striders:

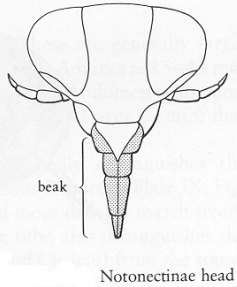
- catch one of the mosquitoes that is biting you and toss it into the stream and watch what happens!
- find a smooth, thin stick; place it in the water near a water strider and twirl it between your two hands making a little whirlpool in the water; often the water strider will scoot over to investigate

True Bugs (Hemiptera)

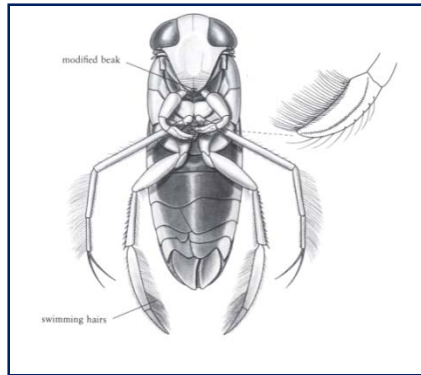
Backswimmers (Notonectidae)



- stout segmented beaks
- keeled back
- predators (can even eat small tadpoles)
- swim on back
- often counter-shaded (light back which faces down into water, darker “belly” which faces up toward sky)
- use underside of water surface tension
- holds air along rows of hairs on abdomen; air obtained by sticking abdomen through water surface



Waterboatmen (Corixidae)



- short, blunt, unsegmented beak
- swim upright
- silvery air bubble held on underside of body; use like lung
- eat plants and suck plant juices
- if water sticks to itself and sticks to other things ... what happens when fine hairs are on appendages of aquatic critters? They act like paddles – water gets “stuck” in between” them. Try this with grains of rice, honey, and a fork.

Life Cycle of Pacific Newts (a)



1. When the rains begin, migration to breeding area starts. The first animals to the ponds are the males.



3. The first couple of females to the ponds get swarmed by males (newt balls). Female exudes chemicals; 1 female in center of cluster; probably pretty stressful for these females.

Later in the season it is one-on-one



Amplexus: Male grasps female with rouhened nads.



The male has a gland (mental gland) under chin that produces an appeasement chemical. He presses his chin onto the head of the female, releasing the chemical, she absorbs it ... and is chemically induced into compliance. The male will also stroke the female's vent to get her into the mood

4. Amplexus



2. Males' skin smoothes out, they get puffy and slimy; their limbs inflate; their vent becomes swollen; their tail becomes wide and flat (it has gone from a storage structure to a swimming structure); rough pads appear on feet to grasp the female

5. When the female is ready, she starts following the male. He will then find a flat spot in the stream and deposit a package containing protein and sperm. The female walks over the sperm packet and takes it up inside her. So although there is no copulation, there is internal fertilization.



Prepared by
Gwen Heistand
for ACR education

Life Cycle of Pacific Newts (b)



Rough-skinned newts lay eggs singly, California newts lay eggs in clumps



6.



The female lays her eggs and leaves. Incubation times may vary from 14 - 52 days

7.

Eggs develop

8.

Larvae hatch



California Newt terrestrial adult

10.

After the mating season most newts return to dry land. Terrestrial individuals are relatively inactive in subterranean refuges most of the year. They need to maintain moist skin and produce their own skin moisture.



Rough-skinned newt: terrestrial adult

9.

Larvae transform into adults at end of the summer or in early fall

How old do newts get? We don't know! There are newts in captivity that are 30 years old that were captured as adults.

Pictures from:
www.californianewts.com
May Chen
California Academy of Sciences
Thanks to David Herlocker for his great information.

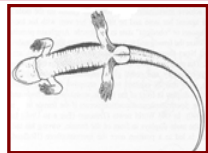
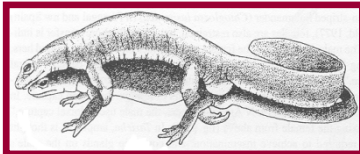
Amphibians found in ACR Streams & Ponds



Rough Skinned Newt (eyes is in dark) California Newt (eye is in light)

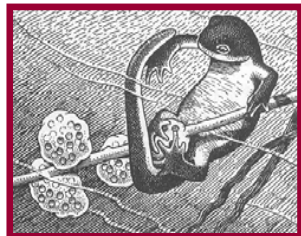
← Red-Bellied Newt (black eye)

↓ Newts in amplexus ↑



← California Newt Male Swollen vent

↑ California Newt laying eggs →



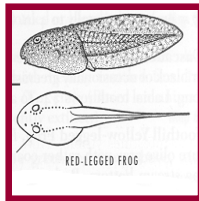
↑ Red-Bellied Newt larvae (dorsal fin does not reach shoulders)



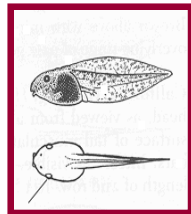
Pacific Tree Frog (look for eye stripe)



↑ California Newt larvae (note stripe on back)



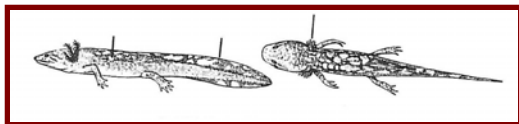
Red-legged Frog (eyes on top)



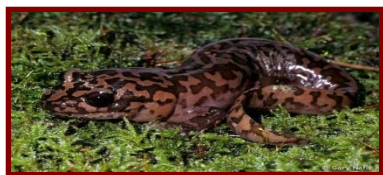
Pacific Tree Frog (eyes on side)



↑ Rough Skinned Newt Larvae



Pacific Giant Salamander Larvae ↑ Adult → (square head, paler with mottling, fast, bushy gills)



True Bugs (Hemiptera) Giant Water Bugs (Belostomatidae)



also called: **toe-biter** and **electric light bug**



- eats other insects, tadpoles, small fish, salamanders
- breathes by raising tip of abdomen to water surface and extending two tail-like breathing tubes which pull in oxygen
- found in shallow pools; in bottom vegetation
- front legs grasp prey; powerful sucking beak is thrust into victim; can stab suddenly injecting numbing liquid, then digestive enzymes
- feigns death if picked up
- female glues eggs to back of male; he will care for them until they hatch

...At the end of the island I noticed a small green frog. He was exactly half in and half out of the water, looking like a schematic diagram of an amphibian, and he didn't jump.

He didn't jump; I crept closer.... Just as I looked at him, he slowly crumpled and began to sag. The spirit vanished from his eyes as if snuffed. His skin emptied and dropped; his very skull seemed to collapse and settle like a kicked tent. He was shrinking before my eyes like a deflating football. I watched the taut, glistening skin on his shoulders ruck, and rumple, and fall. Soon, part of his skin, formless as a pricked balloon, lay in floating folds like bright scum on top of the water; it was a monstrous and terrifying thing. I gaped bewildered, appalled. An oval shadow hung in the water behind the drained frog; then the shadow glided away. The frog skin bag started to sink.

I had read about the giant water bug, but never seen one. ...Its grasping forelegs are mighty and booked inward. It seizes a victim with these legs, hugs it tight, and paralyzes it with enzymes injected during a vicious bite. That one bite is the only bite it ever takes. Through the puncture shoot the poisons that dissolve the victim's muscles and bones and organs — all but the skin — and through it the giant water bug sucks out the victim's body, reduced to a juice.

Annie Dillard, *Pilgrim at Tinker Creek*

Caddisflies (Trichoptera)



larva crawling out of larval case



- some make larval cases, some don't
- often find on underside of
- adults look like wimpy moths with wings folded over back

NORTHERN CASE-MAKERS (Limnephilidae)



Figure 14.58. *Dicosmoecus* larval case



Figure 14.59. *Limnephilus* larval case



Figure 14.60. *Limnephilus* larval case



Figure 14.61. *Pycnopsycha* larval case

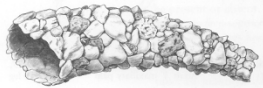


Figure 14.62. *Apatania* larval case



Figure 14.63. *Neophylax* larval case



Figure 14.64. *Furula* larval case



Figure 14.65. *Manophylax* larval case

Aquatic Wee Beasties

Crustaceans



copepods (egg sacs attached)



scuds (amphipods)



daphnia (water fleas) can see internal organs



ostracods (seed shrimp) two valves (shells) with shrimp-looking creature inside

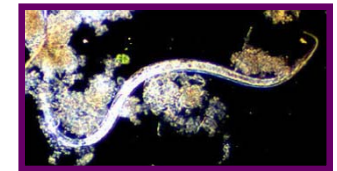
Worm-like critters



annelid worm



freshwater leech



nematode (only longitudinal muscles; characteristic s-like motion)



hydra (related to sea anemones)

rotifers →





Signal crayfish (*Pacifastacus lenisculus*)

- They're fun, they're fascinating, and they're even beautiful in their own lobster way. But signal crayfish are not native to this part of California and they are suspected of causing real damage to our ponds, streams and lakes.
- have been seen in **Stuart Creek for at least 15 years**; relatively easy to spot hiding under over hanging banks and under rocks in the slower moving part of the creek.
- named for the **white spots on their claws**, which look like tiny signal flags
- **native** to the Klamath Basin (mostly Oregon and Washington, but also north of the Klamath River in California) and southwestern Canada
- David Cook found some oddities in the way newt larvae and eggs were distributed in the creek. Red bellied newt larvae were concentrated upstream where crayfish were absent. Some pools that had California newts egg masses in the spring had no larvae by summer.

Some have been seen at BLP ...let us know where and when if you see any

(Excerpted from Jeanne Wirka's *Nutshell* article; photo by Jeanne Wirka)



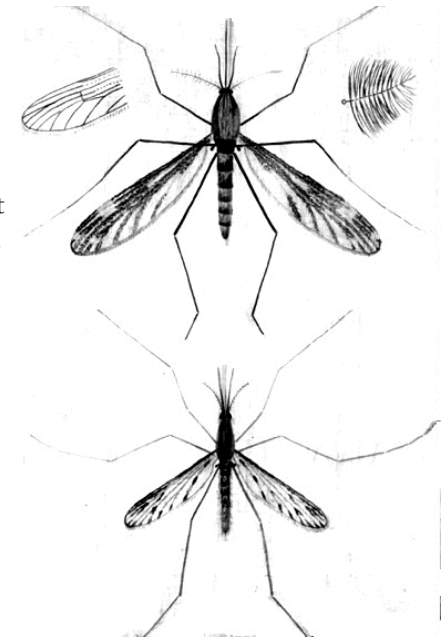
larvae (wigglers)



pupa (tumbler)

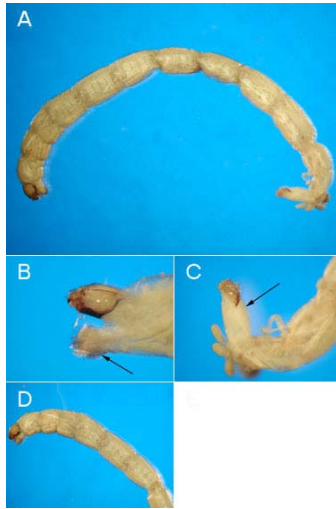
- larvae and pupae must **get oxygen from air** (some species drill into plant tissues and get their oxygen from air-filled spaces in plant tissue)
- **larvae** have **siphon** on hind end to contact air
- **pupae** have **pupal horns** to contact air

A male (top) and female (bottom) mosquito. Sexes can be readily separated by studying the antennae, in males they are plumose (feathery) whilst in females they are pilose (not feathery). A male mosquito is able to locate a female by tuning in to the frequency of the females wing beat. Different species have different wing beats.



Flies (Diptera)

Midges



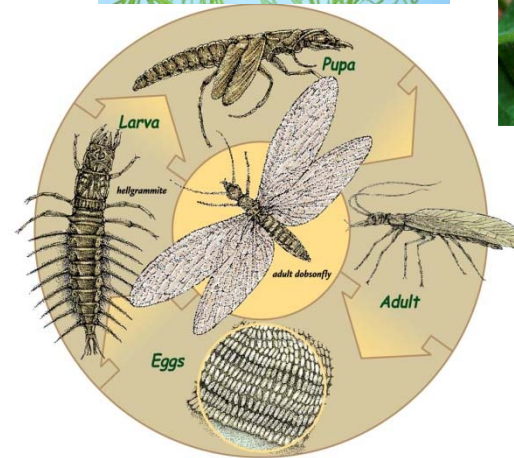
- **Chironomid** midges are often the most abundant
- somewhat **mosquito-like in appearance**, but **lacking scales** on the **wings**, and **do not have a long proboscis** (they do not bite)
- often occur in **huge swarms**, usually in the evening, humming of such a swarm can often be heard from a considerable distance
- larvae of midges occur in **many types of aquatic habitats**
- larvae of chironomid midges have **anterior and posterior prolegs**
- larvae of many midges are **red**, because blood contains **hemoglobin** (known as **bloodworms**)
- often very abundant, and are an important food item for many freshwater fish and other aquatic animals

Phantom Midges



- **transparent**
- **large mouthparts** and **eyes**
- **filter feeders** using their brush-like mouth parts
- **spotted parts** are **swim bladders**, which help them float
- adults do not feed, but their synchronized emergences may create severe nuisance problems around large lakes because adults are highly attracted to lights

Dobsonflies (Megaloptera)



The name **dobsonfly** refers to any species of the genus *Corydalus* (family Corydalidae)

larvae:

- spend **most of life in larval stage** (larvae called **hellgrammites**)
- live **under rocks** at the bottoms of lakes, streams and rivers
- **prey on** other insect larvae
- both male and female hellgrammites have **sharp mandibles**
- **life cycle** (see above): after a few years of living and growing underwater, larvae crawl out onto land and pupate; overwinter in cocoons; emerge only to mate (live only a few days)

adults

- **male mandibles much bigger** than females (unable to harm humans: too long with poor leverage incapable of breaking skin); **used exclusively for grasping females** during mating); **female retain short, powerful pincers** they had as larvae; can inflict painful, nonvenomous bite
- when **threatened**, **raise their heads** and **spread their jaws**
- possess **an irritating, foul-smelling anal spray**, as a last-ditch defense
- can reach lengths up to **5 inches**, measured from the tips of their pincers to the tips of their four wings

Beetles (Coleoptera)

Whirligig Beetles (Gyrinidae)

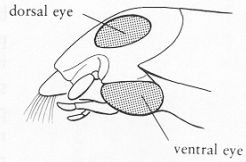
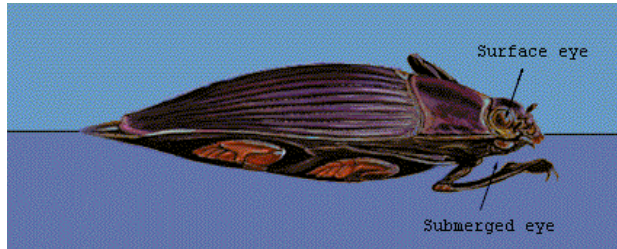


Figure 13.24. Adult, lateral head



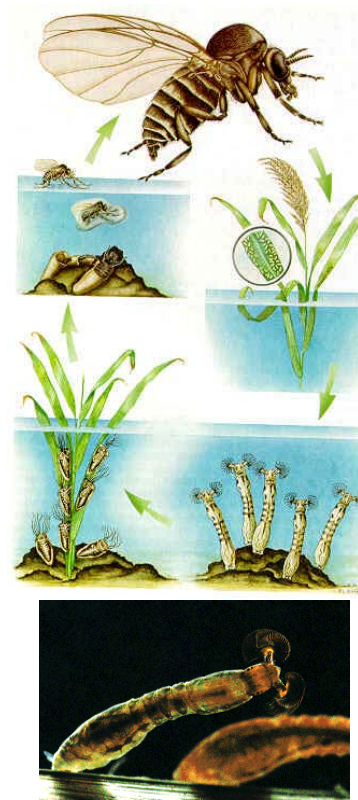
- **4 eyes!** to see above the water and below the water!
- **cuticle** with both **hydrophilic** AND **hydrophobic** properties; enables the ventral surface to be within the water and dorsal part above the water!
- Some say that when these beetles are handled, they give off an **apple-like odor**.
- **What makes them swim around so frenetically?** They are practicing a type of **vibrational sounding**. When they swim faster than 0.23 m/sec (and they can swim up to 1 m/sec) on the surface, they produce waves that spread out in front of them by as much as 6 cm. When they swim in erratic patterns, they produce rings of waves that propagate outward in all directions. The whirligig can then detect objects by their reflection on these waves. A little like echolocation only with movement waves, not sound waves.

Water Pennies

- are actually beetle larvae
- find on undersides of rocks in moving water
- what about their shape makes them suited for this?



Flies (Diptera) Black Flies



- larvae attach **small pad of "silk"** (salivary secretion) to an **object** in the **current**
- use a ring of **hooklets** on their **posterior** end to attach to this pad
- have **brushes** on their anterior end (**labral fans**) that are used to **filter small particles** from the water (filterers)
- Use **fans to feed in different areas of stream flow!!** one is **suspension** feeding, other is using ascending vortex created by body and boundary layer to feed on **detritus** and to **process waste!**
- **As stream velocity increases,** organism actually **slouches lower** in the water column to maintain relationship with boundary layer!
- Adult females bite (and suck blood)

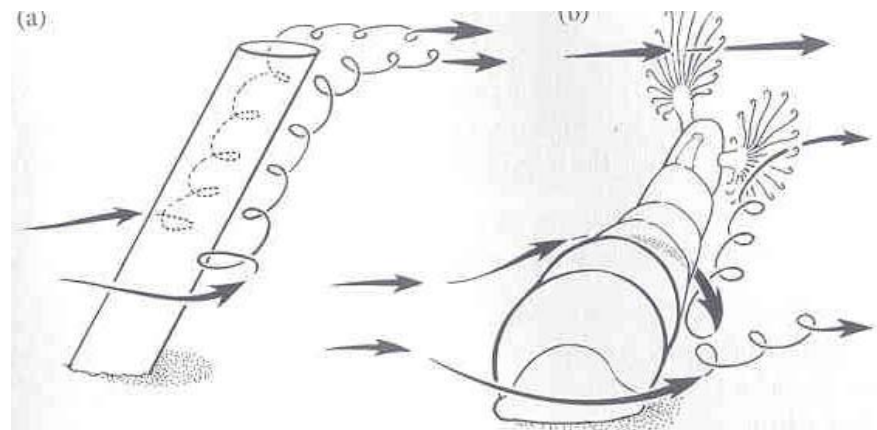


FIGURE 10.7. (a) Ascending vortices behind a cylinder that protrudes from a substratum. (b) How a larval black fly uses an ascending vortex to feed on detritus with one cephalic fan while suspension feeding with the other.

Flies (Diptera): Craneflies (Adults – “Mosquito Eaters”) (Larvae – “Leather jackets”)



Jeanne's great photo of crane fly sex!

Larvae

- has **incomplete/retracted head** and peg-like form distinguishing it from other fly larvae (maggots)
- Find in **moist leaf litter** & **aquatic** environments; eats roots & decaying vegetation
- must come to surface for air

Adults

- **seem to appear suddenly** every spring... **Adult crane flies** are basically **flying sex machines**. They eat nothing, spending most of their time locating mates. (So, they are not mosquito eaters!)
- Crane flies are **true flies** (in the order Diptera); they only have **one pair of wings**. The other pair has evolved over time into structures called **halteres**. Halteres on crane flies are actually big enough to see with the naked eye! Halteres look like little balls on sticks and act as **balancing mechanisms**. Halteres are hollow and fluid-filled. As the critter flies the ball, being heavier, will sway causing the pressure of the stalk to deform the crane fly's exoskeleton. Nerves in the exoskeleton use this information to tell the insect whether it is flying right-side up or upside down. Nifty!
- Because of their size, it's **possible to distinguish males and females in the field**. **Female** crane flies have **tapering abdomens** that terminate in an **ovipositor**. The end of the **male's** abdomen is **expanded and round**. **Males** fly **erratically**, undulating and spiraling. **Female** flight is more **direct, steady, and straight**.
- **Eggs** are generally laid in **most soil** or **water**. Larvae eat decaying plants, fungi, or plant roots. Pupate in mud or soil. Most species overwinter as pupae and metamorphose into adults in spring.

Beetles (Coleoptera)

Predaceous Diving Beetles vs. Water Scavenger Beetles

Predaceous Diving Beetle



adult



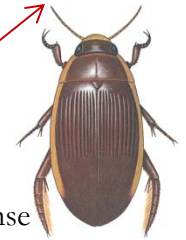
taking air bubble down



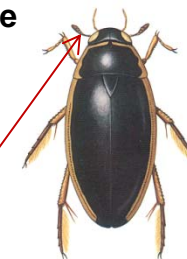
larva capturing tadpole

Adults

- **long swimming hairs** on limbs
- **thread-like antennae longer than the head**
- swim by **rowing back legs together**;
- surface for air with **tip of abdomen first**
- **predators** (including larvae)
- **Interesting note:** Pacific Tree Frog tadpoles sense presence of predaceous diving beetles and increase depth of tail to protect against predation



Water Scavenging Beetle



Adults

- have **short, clubbed antennae** held in small grooves next to eyes
- not as well adapted to swimming as predaceous diving beetles
- **surface for air with head first**
- swim by **moving hind legs alternately** instead of together (like predaceous diving beetle)
- **scavengers**
- **larvae eat decaying plant or animal material**