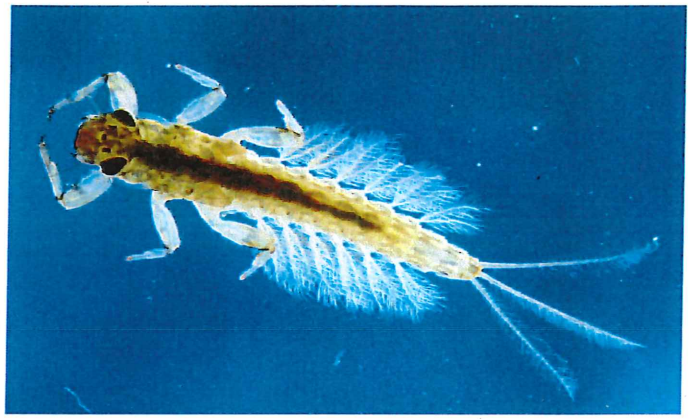
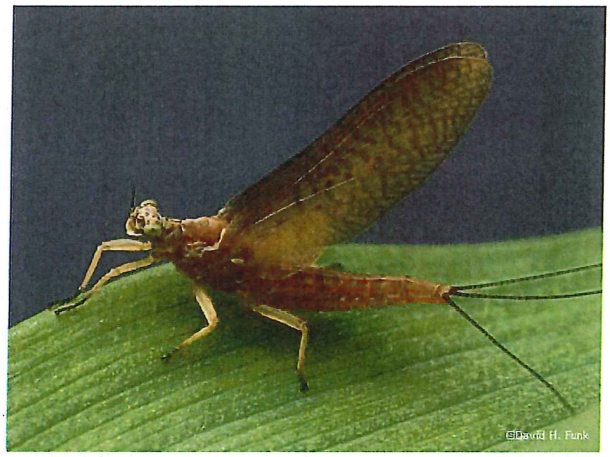
May Flies – Incomplete Metamorphosis – Egg, Nymph, Adult

Egg



Nymph

Dun



Adult (3 tails)

Adult (2 tails)

Eggs

- Eggs, which vary widely in size and surface detail, may be oblong, oval, or rounded.
- Depending on the species, a female may produce fewer than 50 or more than 10,000 eggs.
- Eggs are laid in water and either settle to the bottom or adhere to some submerged object.
- They often hatch in about two weeks but may, under certain circumstances, undergo a period of varying duration in which no growth occurs. This cessation of growth, known as diapause, is a highly effective adaptation that enables the insects to avoid environmental conditions hostile to developing nymphs or to emerging winged stages.

Nymph

- Nymphal life may be as short as two weeks or as long as two years, although an annual cycle is most common.
- As many as 50 molts (periodic shedding of skin) may occur, depending on the species and the environment.
- When growth is complete, the nymphal skin splits down the back and a winged form, called the Dun, emerges.

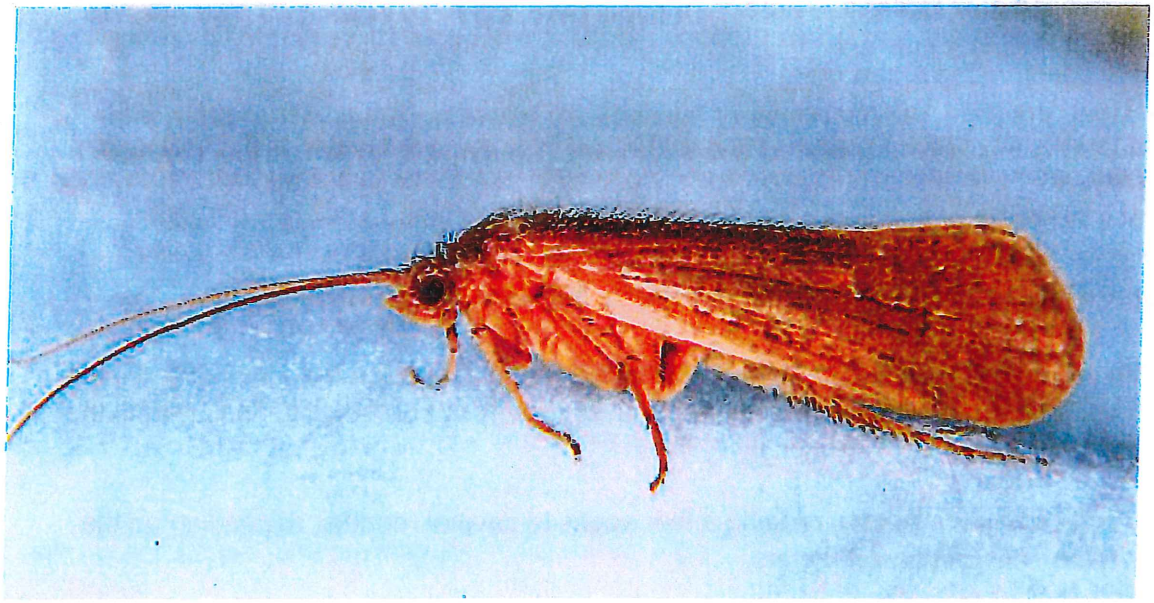
Sub Adults (Dun) and Adults (Spinner)

- The Dun flies from the surface of the water to some sheltered resting place nearby.
- After an interval lasting a few minutes to several days, but usually overnight, the skin is shed for the last time, and the Spinner, (adult stage), emerges.
- Mayflies are the only insects that molt after developing functional wings.
- The Dun resembles the Spinner in overall appearance, although it is softer and duller in colour than the adult.
- The wings of the Dun, generally rather opaque, are tinted with gray, blue, yellow, or olive.
- Heavy pigmentation along the veins may give the wings of the Dun a mottled appearance that rarely persists in the Spinner.
- Legs and tails of the Dun are shorter than are those of the Spinner.
- It is often incorrectly assumed that the two stages are different species
- Mating takes place soon after the final molt.
- In most species death ensues shortly after mating and oviposition (egg deposition).
- Winged existence may last only a few hours.
- Groups of male Duns perform a mating flight, or dance, over water as dusk approaches, flying into any breeze or air current. Individuals may fly up and forward, then float downward and repeat the performance.
- Females soon join the swarm, rising and falling as the dance continues. The male approaches the female from below and behind and grasps her thorax with his elongated front legs.
- Mating is completed on the wing.
- After her release by the male, the female deposits her eggs and dies.

Caddisfly – Complete Metamorphosis – Larva, Pupa, Adult

Larva

Pupa



Adult

Eggs

- Shortly after mating, adult females lay their eggs in or near the water. They walk or dive into the water, and cement their eggs to the base of aquatic vegetation or to stones.
- Caddisfly eggs will not hatch until moisture is present.
- The eggs are laid within a gelatinous matrix; the presence of moisture triggers hatching, and the larvae break out of the gelatinous matrix to begin spinning nets of silk or building cases.

Larvae

- Caddisfly larvae usually go through 5 stages of development (called instars).
- Upon hatching, the first instar of the larvae sometimes remains in the gelatinous mass for a period of time, after which they break out of the matrix and begin constructing a case or silk net.
- When environmental conditions are favourable, the larvae continue to development through instars. When conditions are not favourable, the development process is delayed until conditions improve.
- During winter, larvae living in shallow water may be covered embedded in ice, sometimes for a period of up to 6 months, tolerating temperatures as low as -10dC. Most caddisfly larvae overwinter as larvae, having very little growth during this time.
- Some larvae, however, do not freeze when the water surrounding them does; others overwinter eggs inside the gelatinous matrix, which provides protection.
- Thus, caddisflies may hibernate during the winter as either larvae or eggs.
- The fifth instar of larval development lasts the longest; during this stage, the larvae does the most feeding to prepare to pupate.
- During the final instar, the larvae produce a pupal case, either by sealing off their existing case or constructing a new one.

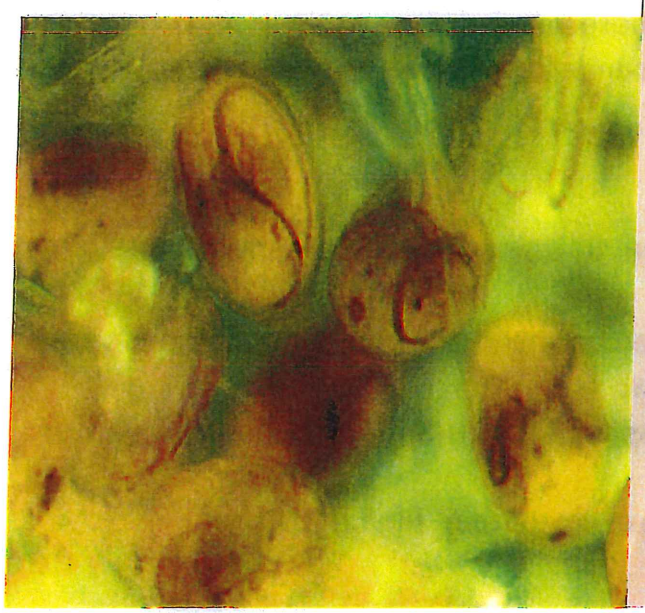
Pupae

- After sealing the case, the final instar of the caddisfly larvae becomes stiff, shorter, and broader, losing flexibility in the head and abdomen. This stage is known as the 'prepupal resting stage'.
- This process occurs under water, and is influenced by many factors, including water temperature, light exposure, altitude, and the availability of nutrients.
- The pupal stage usually lasts about 2 to 3 weeks, but some species may overwinter as pupae.
- When the pupae has developed into an adult and is ready to emerge from the case, it uses specialized appendages, called mandibles, to chew its way out of the case and swim to the surface of the water.

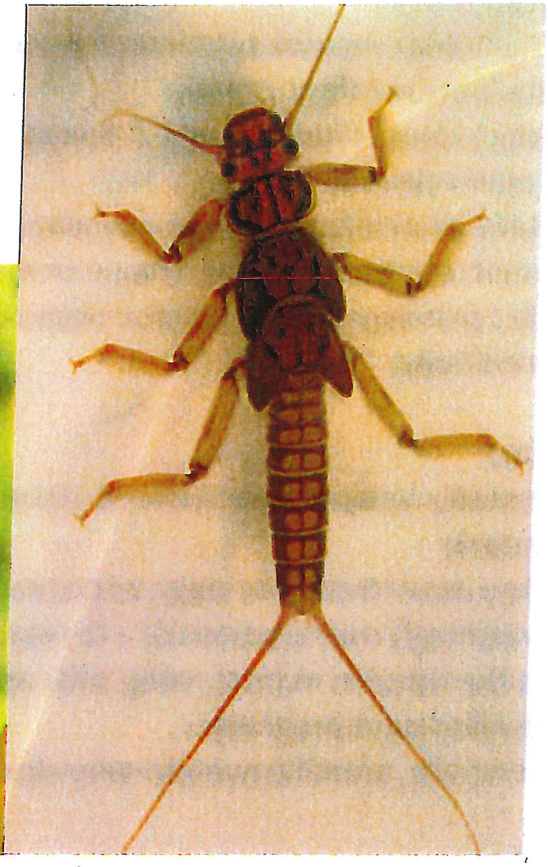
Adults

- Adult caddisflies have a lifespan ranging a few weeks to several months, depending on the species and on environmental factors.
- They are generally nocturnal.
- Upon emergence from the papal stage, adults are ready to mate. They may mate while in flight, on nearby vegetation, or on the ground.
- Mating rituals may involve the use of chemicals to attract females (called pheromones), while males of other species gather in large swarms and display mating dances to attract females. Some may also make species-specific sounds.

Stonefly – Incomplete Metamorphosis – Egg, Nymph, Adult



Eggs



Nymph

Adult

Adult

Eggs

- After mating, the female deposits large masses of eggs.
- To lay the eggs, the female flies over the water and may dip her abdomen in the water, releasing the eggs, or may drop the eggs directly into the water from the air.
- The female may also submerge herself into the water and deposit the eggs on the bottom of the stream.
- Many species require only 2-3 weeks for hatching, while some larger forms require several months.
- Before hatching, the eggs may enter a resting phase (called 'diapauses') that could last three months to one or more years.
- This prolonged resting phase occurs when temperatures increase, causing dry conditions.

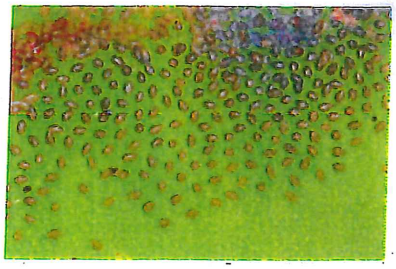
Nymphs

- Stonefly nymphs have between 10 to 30 stages of development (called instars)
- They move from one stage to the next by shedding their exoskeleton (called 'moulting') over a period of 1-3 years.
- As the nymphs mature, wing pads appear and continue to become larger as development progresses.
- Generally, stonefly nymphs very closely resemble the adult stage.

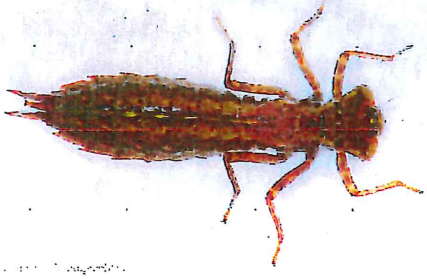
Adults

- When the nymphs reach their last instar, they crawl out of the water and moult one last time, becoming adults.
- To find a mate, adult stoneflies settle on vegetation and other surfaces near the water. The males try to attract females by using their abdomen to drum, tap or scape on the surface of the rock or log
- These vibrational signals are only attractive to females of the same species.
- A nearby female who is interested will drum back, and they will continue this interaction until they have located each other.
- While males will attempt to mate many times with different females, females will only mate once.
- Adults live for only 1 to 4 weeks.
- In most species, the adult stage feeds but dies shortly after mating.

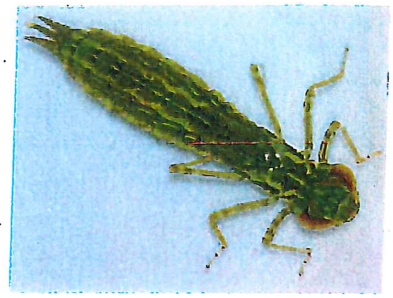
Dragonfly – Incomplete Metamorphosis – Egg, Nymph, Adult



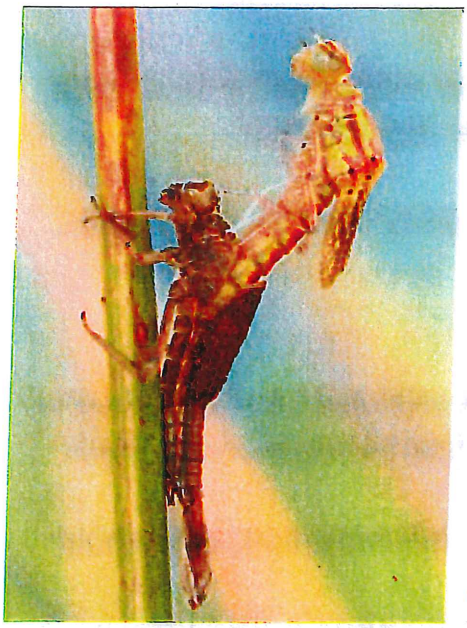
Egg



Nymph

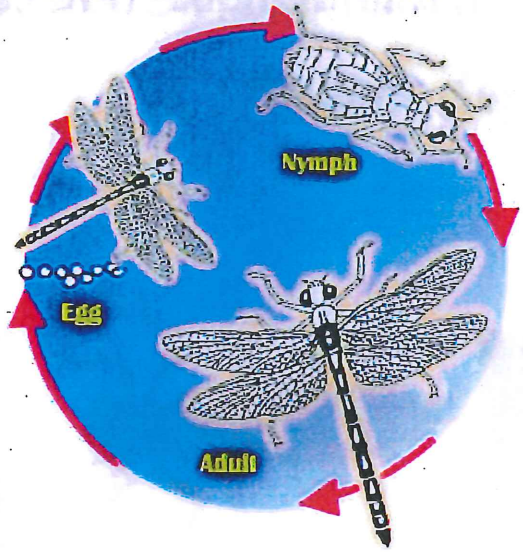


Nymph



Adult emerging from a nymph

Adult



Dragonfly lifecycle

Role in Food Chain

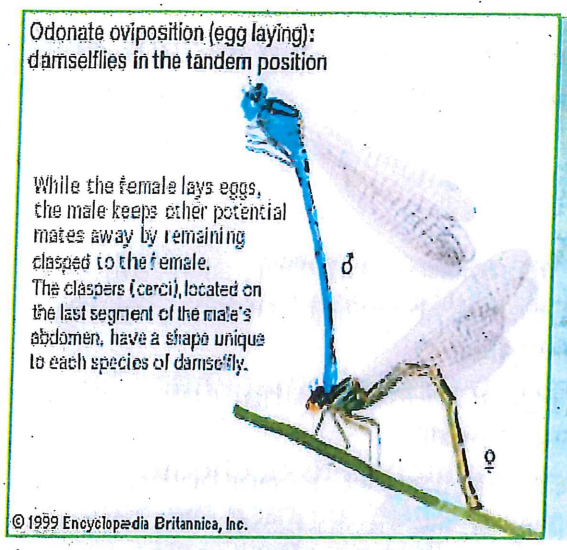
Dragonfly nymphs and adults are the top predators in many aquatic food webs. Drangonfly nymphs are active predators and consume various other invertebrates.

- As adults they consume a large number of insect pests, including mosquitos.

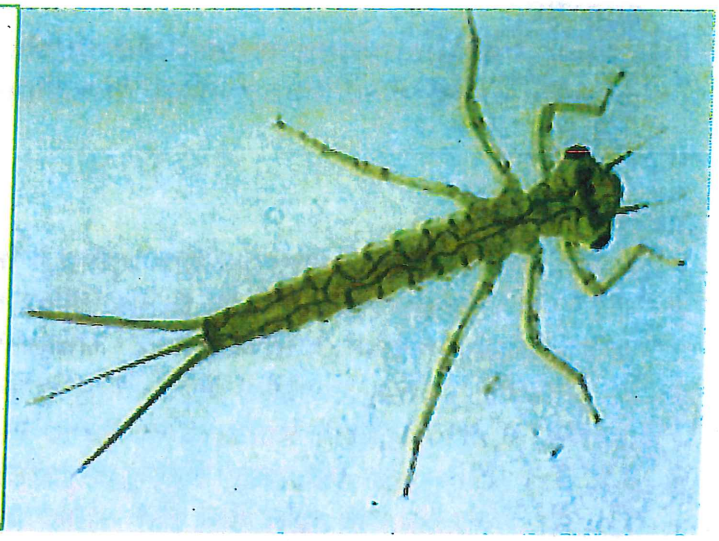
Interesting Facts

- Many species can get up to 7-8 cm long.
- Fossil Dragonflies have wing spans up to 2 metres and were almost a meter in lenght! These giant insects were able to sustain flight because oxygen levels were far higher at this time
- Dragonflies hold their wings horizontally at rest, while most damselflies hold their wings together above the body.
- Drangonflies respire not only through their gills, but also through their wing pads.
- Nymph drangonsflies have gills inside the rear of their abdomen. They obtain oxygen by contracting their abdomen to pump water in and out of the gill chamber. By quickly expelling the water, they are pushed forward by their own 'jet propulsion' system.

Damselfly – Incomplete Metamorphosis – Egg, Nymph, Adult



How eggs are laid



Nymph

Newly emerged

Adult

Eggs

- The female lays the eggs in plant tissue, either submerged in the water, just above the water line, or directly on the water.

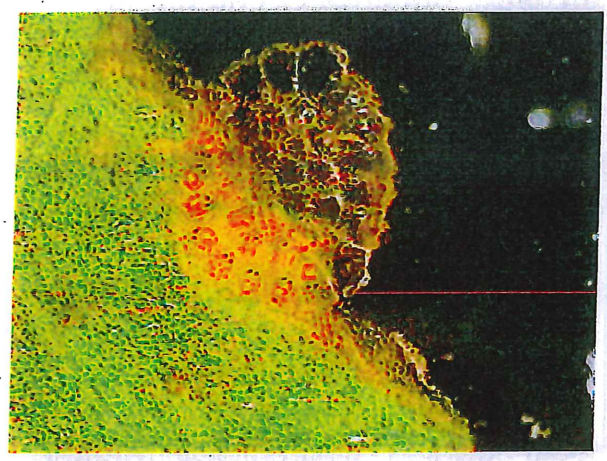
Nymphs

- Upon hatching, nymphs go through approximately 10 to 12 immature stages (called instars) during development, depending on habitat and species.
- When they are ready to become adults, they crawl out of the water and shed their exoskeleton (called 'moulting') one last time to transform into adults.

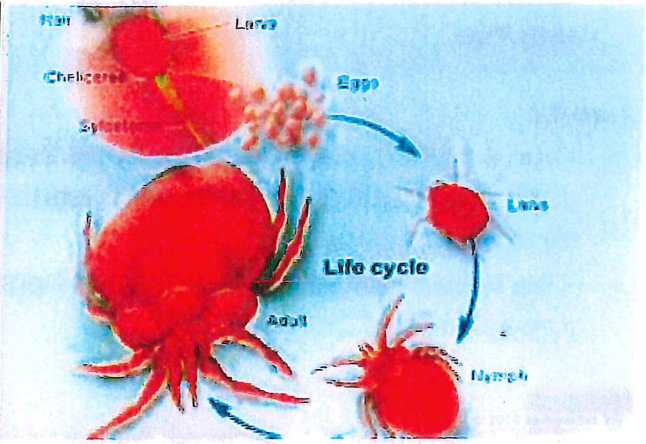
Adults

- Adult damselflies emerge throughout the spring, summer, and fall.
- To find a mate, adult male damselflies patrol shoreline areas seeking out females while chasing away other males.
- In order to mate, a male damselfly will grasp a female that enters his territory, and sperm is transferred to the female.
- Mating pairs can be seen flying in tandem (attached to eachother).
- Depending on the species, the male may continue to grasp the female after egg fertilization. He does this to ensure that no other males can mate with the female while she is on her way to deposit the eggs.
- Adults have a lifespan of only a few weeks to a few months.

Red Water Mite – Incomplete Metamorphosis – Egg, Larva, Nymph, Adult



Eggs



Life Cycle

Adult

Egg

- The female typically attaches the fertilized eggs to submerged water plants.
- After hatching from their underwater eggs, aquatic mite larvae either swim to the surface or crawl along the water substrate to find a food source.

Larvae

- For a period ranging anywhere from a few days to several months, the larvae parasitize a host, and feeds on the host fluids until the larvae reaches maturity.
- The mites parasitize hosts such as damselflies, dragonflies, and other types of flies.

Nymph

- After the mite has completed its parasitic stage in which it was feeding off a host, it transforms from a larva into a nymph called a deutonymph.
- The deutonymph feeds on aquatic insects, crustaceans, and other mites, and grows in size as it feeds.
- It is a stage that resembles the adult form, but is not reproductively mature.
- When it is ready, the deutonymph becomes a tritonymph.
- During this time, it transforms into the sexually mature adult form.

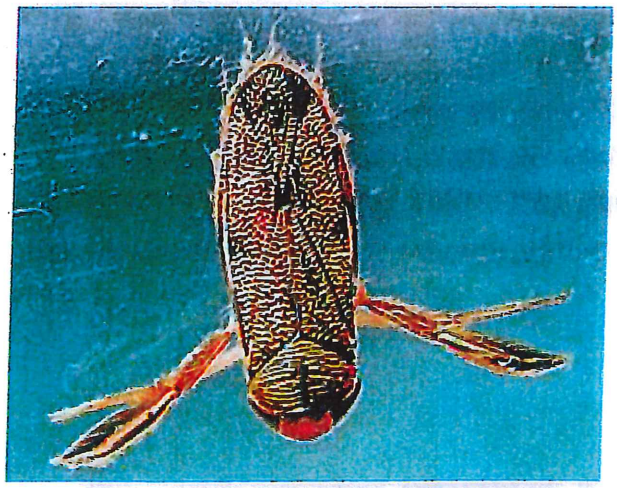
Adult

- As an adult, the water mite feeds on similar prey as it did as a deutonymph, has a fully developed reproductive system, and is ready to mate.
- When they mate, the male grasps the female and transfers a sperm packet to the female and fertilizes her eggs.

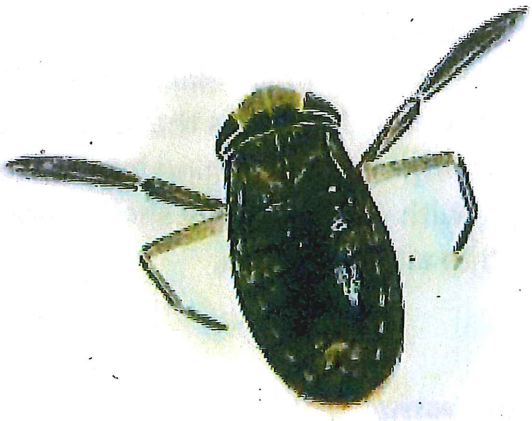
Water Boatman – Incomplete Metamorphosis – Egg, Nymph, Adult

Eggs

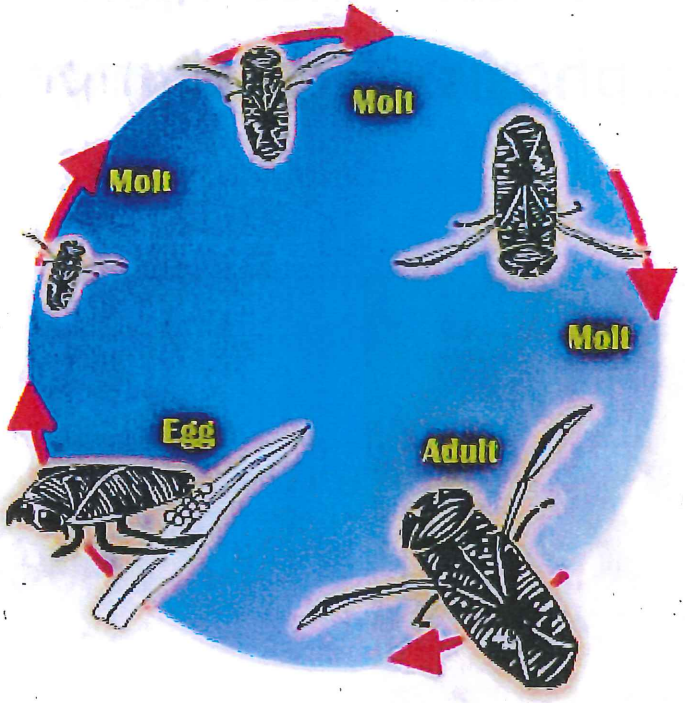
Nymph



Adult



Adult



Water Boatman Life Cycle

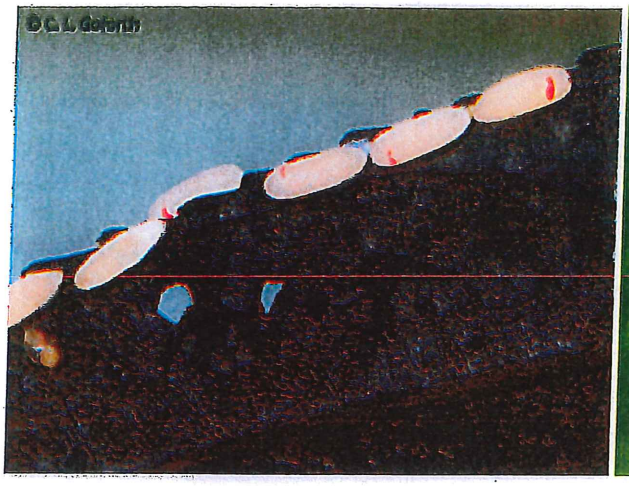
What I look like:

My body is dark brown or black, about 1/2" long, an elongated shape, with short front legs that have a scoop on the end that I use to gather food. I use my oar shaped hind legs to swim, and I swim right side up. I carry my air supply with me, under my shell. I have wings and can fly at night because I am attracted to artificial lights.

How I am born:

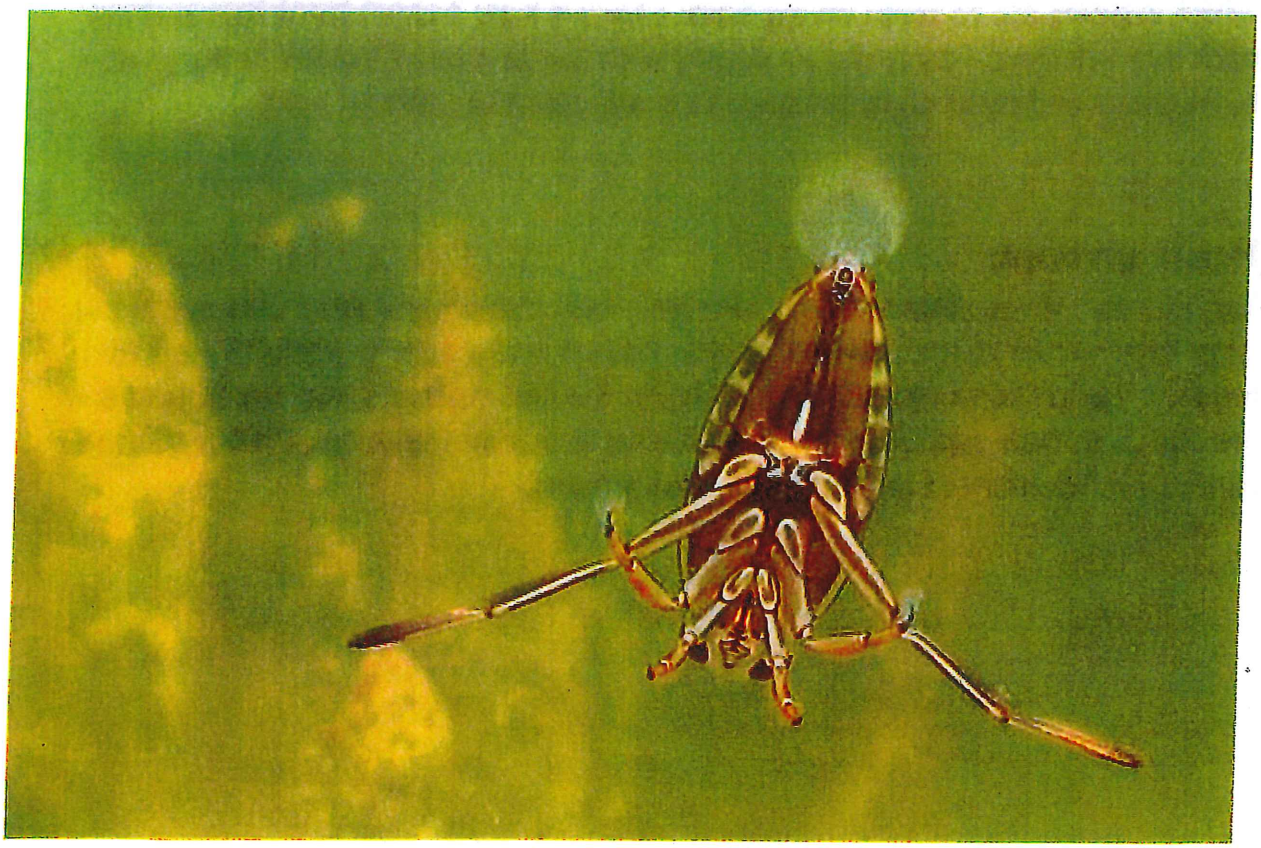
I go through three stages of development or incomplete metamorphosis: egg, nymph and adult. My egg is attached to underwater plants and rocks. I hatch into a nymph and will molt to reach my adult form. I receive my wings in my last molt. It takes me around 6 weeks to go from egg to adult. I can live about a year and even under ice as long as there are air bubbles.

Backswimmer – Incomplete Metamorphosis – Egg, Nymph, Adult



Egg

Nymph



Adult

My Home:

I am often confused with the Water Boatmen insect; however, I can give a stinging painful bite. The easiest way to tell us apart is I swim on my back (upside down). I am found in freshwater ponds, slow moving streams, lakes that have aquatic plants that I can cling to.

What I eat:

I eat other insects, small fish, and even tadpoles. I have tube shaped piercing mouth parts. I use my short front legs to grab and attack my prey with a stinging bite. I use my saliva to dissolve my food so I can suck it through my tube shaped mouth parts.

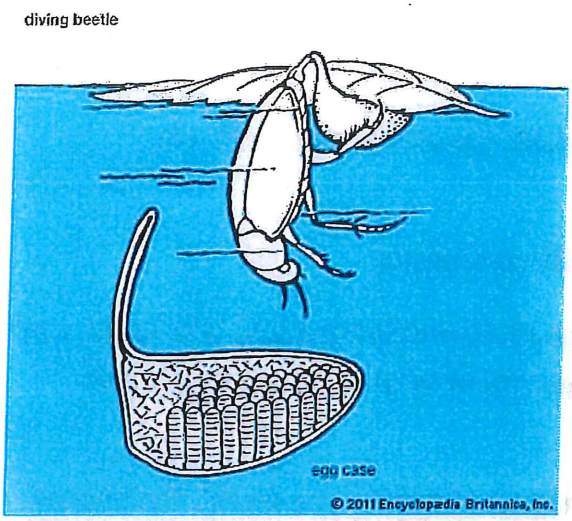
What I look like:

My body is dark, and less than 1/2". My back is oval shaped much like a boat hull, which enables me to swim on my back. I have 6 legs; 2 short front legs and my back legs are long. I carry my air supply with me as a small bubble in my shell. I have wings and fly at night because I am attracted to artificial light.

How I am born:

I go through three stages of development: egg, nymph and adult. My egg is usually attached to underwater plants. I hatch into a nymph and will molt to reach my adult form receiving my wings in the last molt. It takes me around 6 weeks to go from egg to adult. I can live up to a year and even under ice as long as there is food to eat and air bubbles to breath.

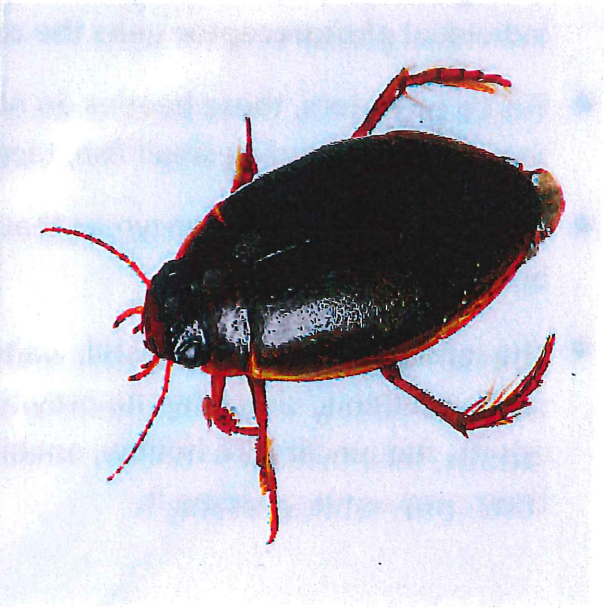
Predaceous Diving Beetle – Complete Metamorphosis – Egg, Larva, Pupa, Adult



Females deposit eggs in water or on aquatic vegetation

Larva a.k.a. Water Tiger

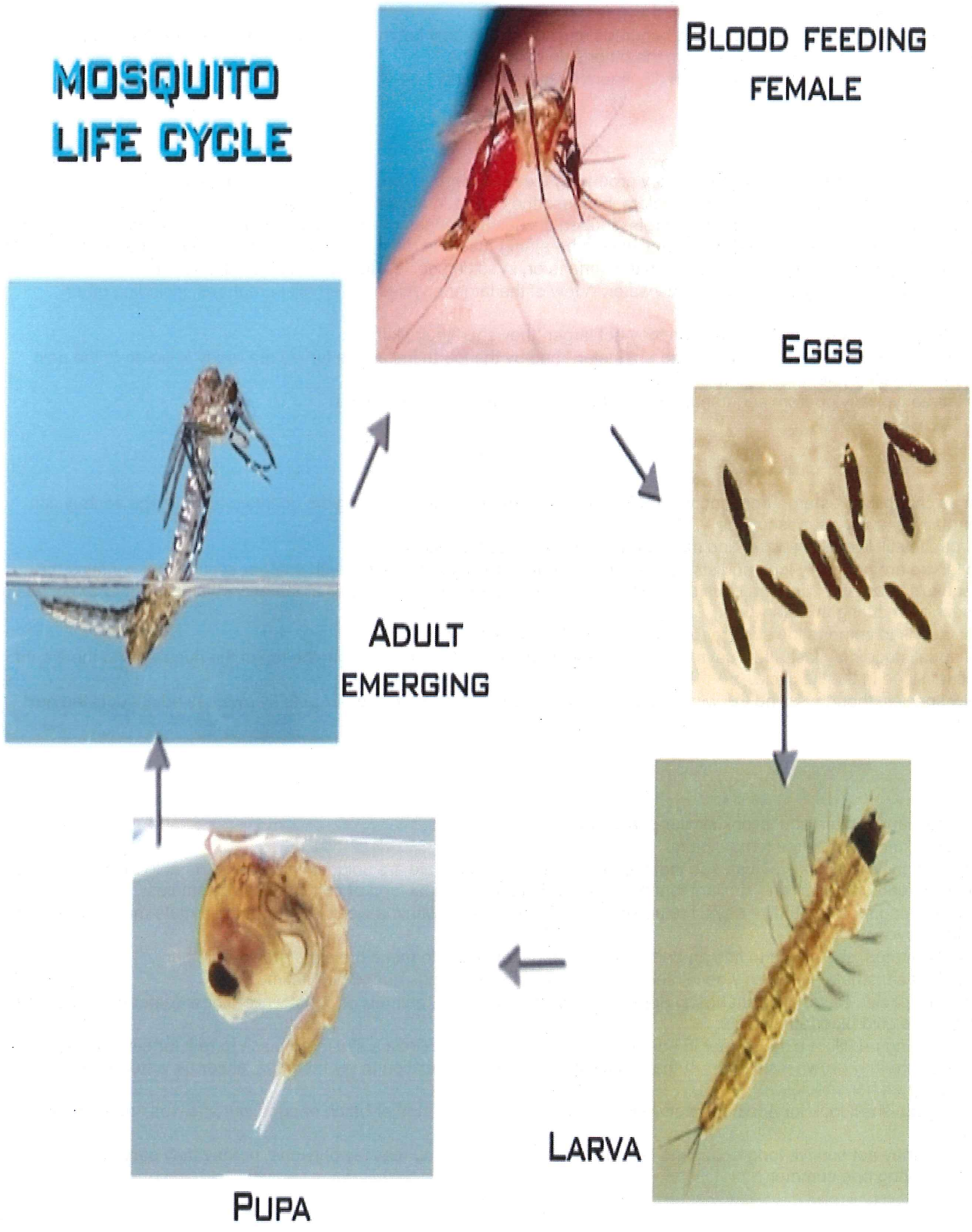
Adult



Adult

- Distinctively shaped body-elongated and oval
- Hind legs flattened and fringed for incresed speed when swimming and diving. The hind lefs are flattened like paddles and have stiff hairs that increase the surface area for better propulsion
- They possess thread-like antennae
- Adults utilize air trapped under a structure called the elytra to stay submerged for long periods of time
- Use a ``frog kick`` with their back legs for swimming
- Beetles are generally characterized by a particularly hard exo-skeleton, and the hard wing-cases which tend to cover the hind part of the body and protect the second wings, the alae.
- The bodies of beetles are divided into three sections, the head, the thorax, and the abdomen, and these in themselves may be composed of several further segments.
- Diving beetles possess compound eyes which contain thousands of individual photoreceptor units the collectively make up the eye.
- Fierce predators, these beetles do not hesitate to attack prey larger then themselves, including small fish, tadpoles and frogs.
- Their sharp jaws inject enzymes that digest their prey so that the juices can be ingested by the beetle.
- The larvae hunt by holding still, waiting with jaws wide open, and then strike suddenly, clutching the prey tightly with their jaws. As with the adults, the pincers are hollow, enabling them to begin sucking the juices of their prey while grasping it.

Mosquito – Complete Metamorphosis – Egg, Larva, Pupa, Adult



Eggs

- All mosquitoes begin their life cycle as eggs, laid either on or near water.
- eggs are tiny, less than a millimeter long.
- They begin white, but darken to black, brown or reddish brown within the first day.
- Some species lay their eggs connected together in rafts which rest on the surface of the water, while others lay the eggs so they float individually.
- These eggs hatch within a few days after they're laid, but other mosquitoes, lay eggs on the soil near water, rather than on the water itself. Their eggs can survive long periods of drought or cold, before rain or snow-melt comes and washes them into water or raises water levels to where they are.
- These kinds of eggs can be transported hundreds of miles before they hatch, and in fact, that's how the Asian tiger mosquito came to the United States from the other side of the globe.
- Mosquitos were breeding back when the dinosaurs roamed the earth

Larvae

- Once any kind of mosquito eggs hatch, they producing the next stage in the life cycle, the larva (plural "larvae").
- They're commonly called wrigglers or wigglers, because they move in the water by wriggling. You can see them swimming or hanging close to the surface in rain barrels, flooded ditches, the edges of swamps or other stagnant water. They live in water but breath air, so like snorkelers, they have a breathing tube and must come close to the surface often to get oxygen.
- When resting, they usually hang down from the surface or, in some species, lie horizontally just below it.
- The larvae eat tiny organic particles in the water. A few of the larger species, eat smaller creatures, including other mosquito larvae.
- While the larvae feed, they grow, and as they get larger, they shed their skin.
- Each stage in between shedding is called an "instar," and by the fourth instar, the larvae are ready to go on to the next stage in their life cycle, the pupa (plural "pupae").
- The larvae typically go from egg to pupa in less than a week, though some take a

Pupae

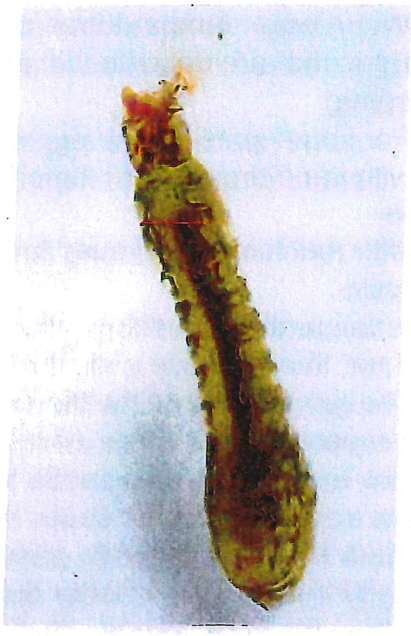
- Just as caterpillars emerge from cocoons to fly away as butterflies, the little wrigglers go into a pupal stage so they can eventually fly away as mosquitoes.
- The pupae still live in the water and move around, though they look different.
- The larvae are generally long and straight, while the pupae are comma-shaped, with a larger section that contains the mosquito's head and front part of its body. The thinner curved section has paddles at the end which allow it to swim, though it doesn't eat during this stage.
- It still needs to come to the surface to breathe through tubes on its head.
- The pupal stage may last a few days, after which the adult mosquito emerges from the top of the pupa up into the air, for the final stage in the life cycle.
- A few species, though, spend the winter in their underwater stages and don't emerge to fly away as adults until the next spring.

Adults

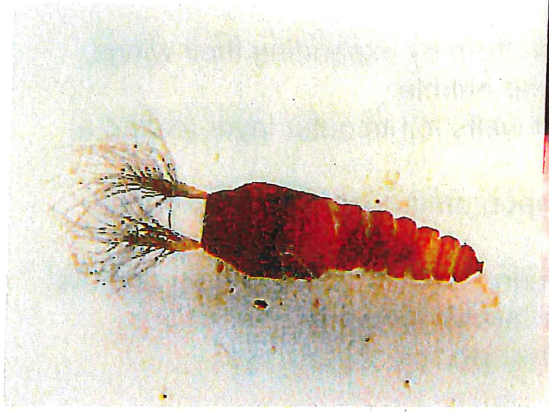
- Both male and female adults look similar at a distance.
- Both buzz, though only the female bites.
- With a magnifying glass, you can see that the mouth parts of the female are uniquely adapted to be able to bite animals, as well as to feed on nectar and similar plant products, which are the usual food of both males and females.
- After maturing for three to five days, the adults mate. The male dies within a week or so, but the female may live several weeks or even months.
- After she mates, she needs to find an animal to get a meal of blood, to make the eggs grow within her.
- Though each female mates only once, she may lay several sets of eggs during her lifetime.
- Different species prefer different hosts. Some will bite either humans, animals or birds, while others prefer one type, and a few choose cold-blooded animals.
- After drinking her fill of blood, either in one bite or several, the female finds a sheltered place to rest for several days until her eggs are fully grown inside her. At that point, she will look for a location to lay the eggs, either on water or near it, depending on her species.
- After laying, she'll look for another creature to bite, so she can grow another batch of eggs, but she won't need to mate again.
- Females may not survive long enough to lay one batch of eggs, or they may lay only one, or they may survive to lay several during one summer.

Blackfly – Complete Metamorphosis – Egg, Larva, Pupa, Adult

Egg



Larva



Pupa

Adult

Eggs

- Eggs are usually deposited in shallow, fast-running water within streams and rivers, often on submerged objects, such as rocks, leaves, and aquatic vegetation.
- The eggs may also be scattered along the surface of the water.
- Female black flies deposit approximately 150 to 500 creamy-white eggs, which usually develop over a period of four to five days.
- They become darker as development progresses.
- When water temperatures reach 70 degrees F, the eggs will be ready to hatch.
- Eggs that are deposited in autumn do not hatch until the water warms the following spring.
- For some species, the egg stage is the resistant stage of the life cycle; some can withstand drought and hatch when conditions are more favourable.

Larvae

- After hatching, the young larvae attach themselves to submerged objects such as rocks.
- In favourable conditions, the black fly larvae will remain at the hatching site.
- If not, they will use a silk thread to drift downstream to sites with better conditions.
- The larval stage of the life cycle can vary in length depending on the water temperature and other environmental conditions.
- The larval stage can persist for anywhere from several weeks, when temperatures are warmer, to six or seven months, when overwintering occurs.
- Black fly larvae typically pass through seven developmental stages, called instars.
- Early instars have shorter durations than later ones.
- When the larva reaches its final instar, it will spin itself a cocoon out of silk, forming a pupa.
- The growth rate of black fly larvae depends greatly on the quality and abundance of food, and on water temperature.

Pupae

- Pupation occurs within a cocoon that is open at one end.
- The length of this stage varies depending on the temperature of the water, but generally lasts from four to seven days.

Adults

- Adult black flies emerge from their pupal cocoon form by expanding their wings, which causes them to float to the surface in an air bubble.
- The adult can then fly to a resting spot, where it waits for its outer layer (called a cuticle) to harden.
- Adult black flies may be ready to mate shortly upon emergence from the pupal form.
- Depending on the species, mating can occur during flight or while landed, and the female will need a meal of blood before or after laying her eggs.
- Whether a blood-meal is needed depends on the species of black fly.

What is the difference between Complete and Incomplete Metamorphosis?

In comparison, there are major differences between these two processes.

• Incomplete metamorphosis has three stages, while complete metamorphosis has four stages.

• Eggs and adults are common stages in both processes, while nymphs are involved in incomplete metamorphosis. However, complete metamorphosis involves with larval and pupal stages in addition to obvious eggs and adult stages.

• Nymphs almost look similar as the adults do, and the food habits are the same in both. However, larva is completely different from the adult in body form as well as food habits.

• There is no pupal stage in incomplete metamorphosis, but complete metamorphosis does have it, and the pupa does not eat and cannot move.