

Forensic Entomology

The study of insects in relation to a criminal investigation. Insects arrive at a decomposing body in a particular order and then complete their life cycle based on the surrounding temperature. By collecting and studying the types of insects found on a body, a forensic entomologist can predict the time of death.

“When one biological clock stops, others begin.”

--Neal Haskell, reknown forensic entomologist

PMI--Postmortem Interval

An estimation of the duration of PMI involves setting the minimal and maximal time between death and corpse discovery and is important in narrowing the field of suspects.

The minimal PMI is determined largely by estimating the age of developing immature insects collected at the time the corpse is discovered.

The maximum PMI is determined from the species of insects that are present and the weather conditions necessary for the specific activity of these species.

Factors that affect decay rate

- Temperature--the warmer the climate, the faster the decay.
- Season--early spring will decay slower, because the insect population is still relatively low.
- Degree of corpse enclosure--the more exposed, the faster the decay.
- Depth of Burial

Ecological Roles of Insects in Decomposition

- Necrophages – species feeding on corpse tissue; mostly true flies and beetles; age determination (larval instar) important for PMI
- Omnivores – insects that feed both on the corpse and associated fauna; ants, wasps and some beetles; may alter rate of decomposition
- Parasites and Predators – many beetles, true flies and wasps that attack immature flies
- Incidentals – use the corpse as a resource extension; springtails, spiders, centipedes, some mites

Initial decay - 0 to 3 days after death

- From the moment of death flies are attracted to bodies.
- Bacteria and the body's own digestive enzymes (normally in the intestine) spread through the body, contributing to its decomposition.
- Without the normal defenses of a living animal, blowflies and house flies are able to lay eggs around wounds and natural body openings (mouth, nose, eyes, anus, genitalia) and any wounds.
- These eggs hatch and move into the body, often within 24 hours. The life cycle of a fly from egg to maggot to fly takes from two to three weeks. It can take considerably longer at low temperatures.



Stage 2: Putrefaction - 4 to 10 days after death

- Putrefaction begins; gases produced by anaerobic bacteria; considerable bloating; seepage of fluids;
- Larval activity speeds up decomposition - the smells and body fluids that begin to emanate from the body attract more blowflies, flesh flies, beetles and mites.
- The later-arriving flies and beetles are predators, feeding on maggots as well as the decaying flesh. They are joined by parasitoid wasps that lay their eggs inside maggots and later, inside pupae.



Stage 3: Black putrefaction - 10 to 20 days after death

- Abdominal wall is broken and carcass deflates
- By this stage, several generations of maggots are present on the body and some have become fully grown.
 - They migrate from the body and bury themselves in the soil where they become pupae.
- Predatory maggots are much more abundant at this stage, and the pioneer flies cease to be attracted to the corpse.
- Predatory beetles lay their eggs in the corpse and their larvae then hatch out and feed on the decaying flesh.
- Parasitoid wasps are much more common, laying their eggs inside maggots and pupae.



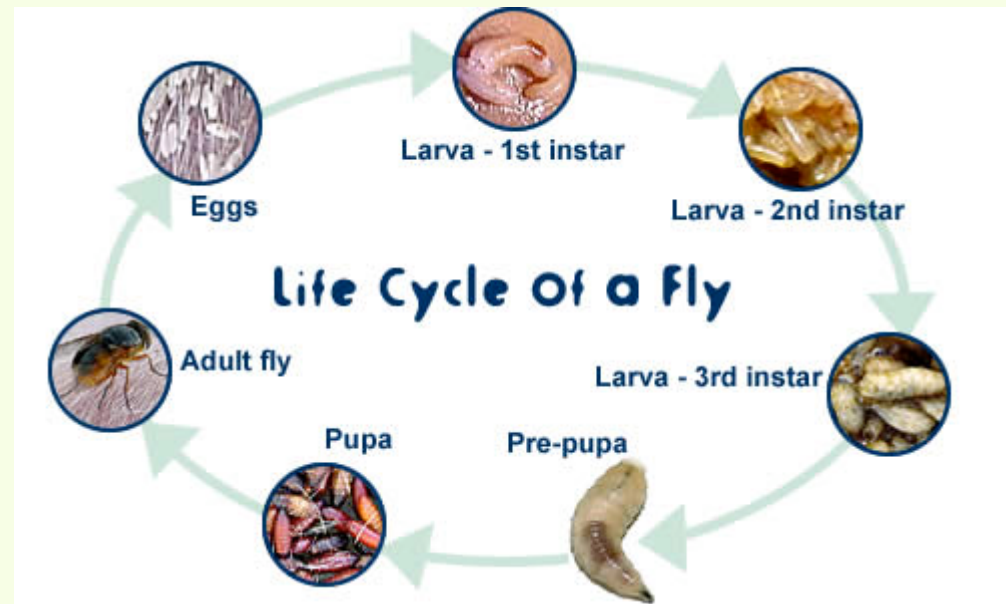
THE BLOW FLY

- Acts as both necrophages and as a predator.
- One of the most common species on dead bodies
- Often arrive within 10 minutes
- Feed on any blood or fluids and then start laying eggs in and around the natural body cavities
- If the food source is exhausted, they will prey on other species in the same genus (*Chrysomya*)



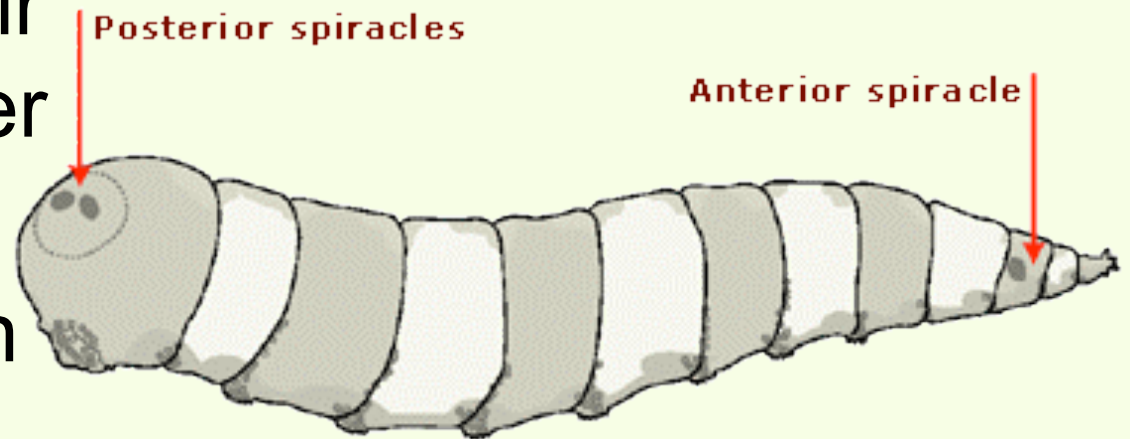
Generalized Fly Life Cycle

- **Eggs**
 - present in clumps of up to 300
 - laying to hatching takes 1 day
- **Larva - 1st instar**
 - initially feeds on fluid exuded from the body
 - migrates into body
 - hatching to first molt takes 1 day
- **Larva - 2nd instar**
 - moves around in maggot mass
 - first molt to second molt takes 1 day
- **Larva - 3rd instar**
 - still moves in mass
 - greatly increases in size
 - second molt to pre-pupa takes 2 days
- **Pre-pupa**
 - migrates away from the corpse seeking a suitable pupation site
 - does not feed
 - transforms into pupa
 - pre-pupa to pupa takes 4 days
- **Pupa**
 - resides within puparium
 - undergoes transformation from larval body form adult fly
 - does not feed
 - pupa to emergence takes 10 days
- **Adult fly**
 - mates on emergence from pupa
 - feeds on protein from body fluids
 - lays eggs on corpse
 - emergence to egg laying takes 2 days

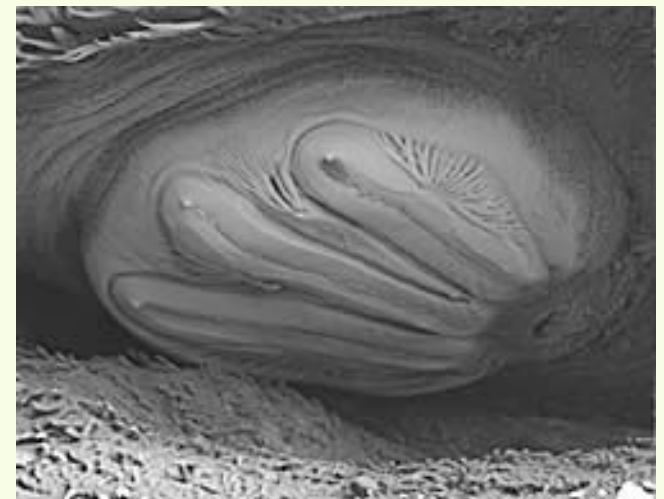
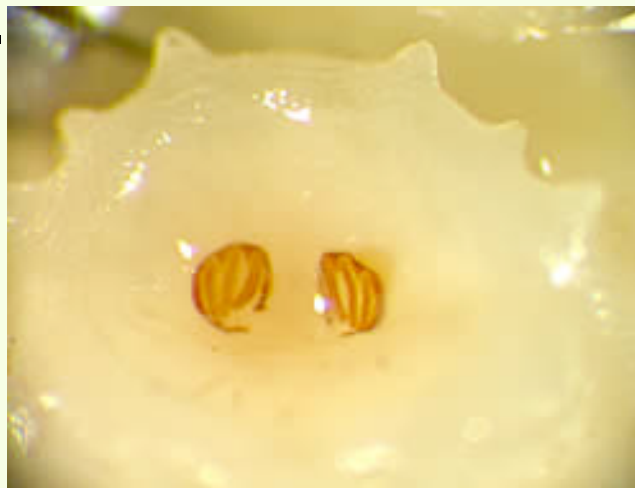


Larva

- Molt (shed their skin) twice after hatching.
- Breathe through anterior and posterior slits called spiracles



- Maggots (fly larvae) are remarkable eating machines.
- Their rear ends consist of a chamber, in which their anus and *posterior spiracles* are located. (They also have anterior spiracles).
- Spiracles are used for breathing, and the possession of spiracles in a posterior location means that maggots can breath feeding 24 hours a day.



Spiracles are distinct

- Different species of fly larva have different spiracle characteristics

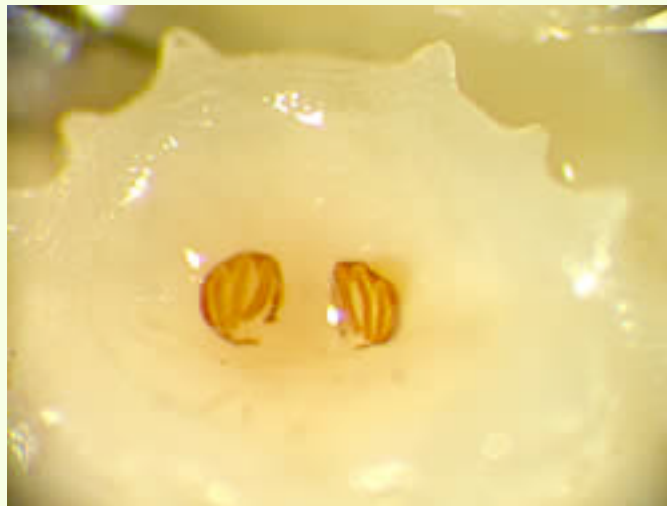
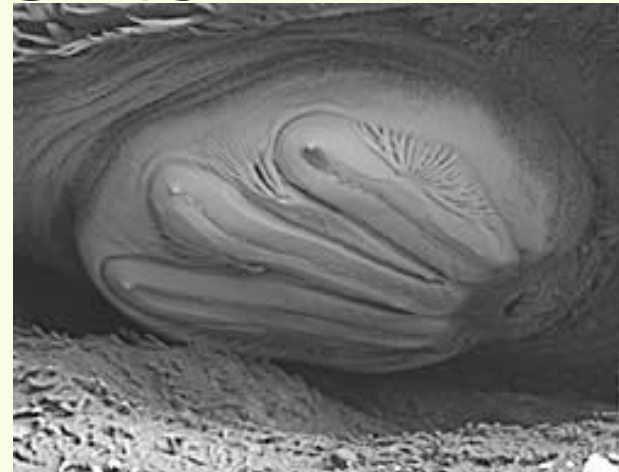
Peritreme

Spiracular Slits



Identifying Maggots by Spiracular Slits

- Maggots can be identified by their distinguishing spiracular slits.



House Fly

- Spiracular Slits



Pupa

- Once larva mature they stop eating and metamorphose into an adult fly.



A



B



C

Forensic Flies



Calliphora dubia
(BLUEBODIED BLOWFLY)



Calliphora albifrontalis
(WESTERN GOLDEN-HAIRED BLOWFLY)



Lucilia sericata
(GREEN BLOWFLY)



Hydrotaea rostrata
(BLACK CARRION FLY)



Chrysomya rufifacies
(HAIRY MAGGOT BLOWFLY)



Chrysomya megacephala
(ORIENTAL LATRINE FLY)



Chrysomya varipes
(SMALL HAIRY MAGGOT BLOWFLY)



Sarcophagid
(FLESHFLY)

Blowflies - Family Calliphoridae



Flesh flies - Family Sarcophagidae



Hister Beetles Prey on Blowfly Larvae



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Hister sinuatus 10190

Coleoptera: Staphylinidae

(staf-fuh-LYNN-ni-dee) rove beetles

- Elytra short, **3-6 abdominal segments exposed**
- Elongate, 0.7-25 mm
- Distinguished from Dermaptera by lack of pinchers
- Most predaceous; some feed on decaying veg, some parasitic

