Forensic Entomology
Metamorphosis

Process by which an organism undergoes distinct changes from young to adult form.

Occurs in some insects, amphibians, mollusks, crustaceans, Cnidarians, echinoderms and tunicates.
Simple Metamorphosis

Egg case

Early instars or nymphs

Later instars

Adult
Complete Metamorphosis

- Egg
- Early instar
- Larva or caterpillar
- Adult
- Pupa or Chrysalis
Growth with an Exoskeleton
Insects are cold blooded.

- The speed of insect growth is directly dependent on temperature.
- The warmer the weather, the less time it will take for the cycle to complete.
Insects that undergo complete metamorphosis:

- Ants
- Bees
- Beetles
- Butterflies
- Fleas
- Moths
- Wasps

Flies
How can information about life cycles be used to solve crimes?
Three Factors allow Forensic Entomologists to use Insect Data to Solve Crime Scenes:

1. Insects are cold blooded and grow in response to temperature. The warmer the temperature, the faster they grow.

2. Insects have an exoskeleton and grow in huge spurts after each molt.
3) Insects arrive at a decomposing body in a successional order and then complete their life cycle based on the surrounding temperature.

Succession: Process of orderly changes in the organisms in an ecological area. The decomposing body becomes an ecosystem.
By collecting and studying the ages and types of insects found on a body, a forensic entomologist can predict the time of death.
PMI-Post Mortem Interval

The PMI indicates how long a body has been exposed to insect colonization. It is not necessarily the accurate time of death. It represents the minimal time of exposure to insects.

PMI can be used to determine the time of death (TOD).

The TOD can be used to narrow the suspects in a crime. Suspects without an alibi would be in question.
“When one biological clock stops, others begin.”

---Neal Haskell, renown forensic entomologist

Flies lay eggs on a corpse within minutes of its exposure.

Time of first exposure may be the time of death (some exceptions).

The PMI indicates the age of the oldest insects on the body.

The age of a larvae at collection minus the time of collection, may be the time of death (TOD).
Flies that feed on CARRION (dead and decaying flesh) undergo complete metamorphosis.
Eggs hatch within 2-3 days.
Fly Larvae

Larvae, or maggots, hatch from the eggs and increase in size by growth steps called INSTARS.

Two larval instars.
Chrysoma rufifacies larvae-hairy maggot blowfly

Anterior-head end

Posterior end

Breathing Spiracles
Maggots act as **DECOMPOSERS** of organic materials.

Shorter, smaller maggots are earlier instars. Longer maggots are later instars.
Eventually the larvae migrate from the corpse and develop into an inactive, pupal stage after which the adult fly emerges.
Timetable of General Fly Development at 27°C (80°F):

Egg Stage 10-30 hours

1st instar larvae 11-38 hours

2nd instar larvae 8-54 hours

3rd instar larvae feeding stage 20-96 hours

3rd instar wandering stage 40-504 hours

Pupal stage 4-18 days

Total 11-48 days
Different Species of Fly Maggots

You may collect different sizes of maggots at the same time:
1) Maggots may be different ages (eggs were laid at different times) or
2) they may be different species of flies (grow at different rates).
The high metabolic rate of the maggots can cause the maggot masses to heat up. Maggots move from the middle of the maggot mass where they feed, to outer areas where they can breathe and cool down.
Insects are attracted to different stages of decomposition.

<table>
<thead>
<tr>
<th>Insect family</th>
<th>Fresh</th>
<th>Bloated</th>
<th>Decay</th>
<th>Dry</th>
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<tbody>
<tr>
<td>Blow flies</td>
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<tr>
<td>Carrion beetles</td>
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<tr>
<td>Flesh flies</td>
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<tr>
<td>Rove beetles</td>
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<td>Sap beetles</td>
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<td>Dermestids</td>
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<td>Grubs</td>
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Four Main Types of Carrion Species

I. NECROPHAGOUS-feed directly on the corpse
   - Flies-Blow flies and flesh flies arrive minutes after death
   - Beetles-arrive later, after the body has begun to dry
Necrophagous Flies

Greenbottle fly

Blow fly
Dermestid Beetle

Adults and larvae feed on carrion.
Carrion Beetle—Feed on corpse and on maggots

Silphidae (*Nicrophorus* sp.)
Types of Carrion Species (Cont)

II. PREDATORS of Necrophagous species

- Burying beetles (family Silphidae)
- Rove beetles (family Staphylinidae)
- Hister beetles (family Histeridae)
Rove Beetle--Staphylinidae

*Lathrobium* sp.

*Nicrophorus marginatus*

Red and black burying beetle
Carrion Beetle *Ptomaphila perlata* with a maggot in its jaws.

Hister Beetle from the genus *Saprinus*. 
Types of Carrion Species (cont.)

III. PARASITES of the Necrophagous species--attracted to other animals already feeding on the body

Mainly parasitic wasps
IV. ARTHROPODS that use the corpse as an extension of their normal habitat

- Hunting spiders
Collection of Arthropods

Three methods:

- Aerial
- Hand
- Live Sampling
Aerial Collection

Use a net and sweep it back and forth over the decomposing body.

(In this example a pig is used as it is the closest to human in decomposition.)
Hand Collection

Collect a variety of maggots with forceps. Place them in boiling water to stretch them out and fix them.
Live Sampling “Maggot Motels”

Maggot samples are placed in containers with food and reared to adult.

Adult flies are easier to identify to species.

Maggots can be analyzed for DNA and identified to species.

Maggots can also be analyzed for the presence of drugs.
You Tube
"Decomposition with Music"
PBS Nature Eggs to Maggots
Yes inspector, it's another cold blooded murder!