Forensic Entomology

Insects as Evidence

Warning: Some material in this presentation and related videos may be too graphic for some people.

T. Trimpe 2009 http://sciencespot.net/

What do they do?

Forensic entomologists apply their knowledge of entomology to provide information for criminal investigations.

A forensic entomologist's job may include:

- Identification of insects at various stages of their life cycle, such as eggs, larva, and adults.
- Collection and preservation of insects as evidence.
- Determining an estimate for the postmortem interval or PMI (the time between death and the discovery of the body) using factors such as insect evidence, weather conditions, location and condition of the body, etc.
- Testifying in court to explain insect-related evidence found at a crime scene.

Did you know? Maggots can be used to test a corpse for the presence of poisons or drugs. Some drugs can speed up or slow down the insect's development.

Cool Jobs: Forensic Entomology Discovery Video

Insects as Evidence

Forensic entomologists use their knowledge of **insects** and their **life cycles** and **behaviors** to give them clues about a crime.

Blow Fly

Carrion Beetle

Most insects used in investigations are in two major orders:

1 – Flies (**Diptera**) and

2 – Beetles (**Coleoptera**)

Species succession may also provide clues for investigators. Some species may to feed on a fresh corpse, while another species may prefer to feed on one that has been dead for two weeks. Investigators will also find other insect species that prey on the insects feeding on the corpse.

Succession wave	Principle insect fauna	State of corpse	Age of corpse
1	Flies (blow flies)	Fresh	First 3 months
2	Flies (blow flies and flesh flies)	Odour	
3	Dermestid beetles	Fats are rancid	3-6 months
4	Various flies		
5	Various flies and beetles	Ammonia fermentation	4-8 months
6	Mites		6-12 months
7	Dermestid beetles	Completely dry	1-3 years
8	Beetles		3+ years

Taken from Smith, K. G. V. 1986, A manual of forensic entomology. Cornell Univ. Press, Ithaca, NY.

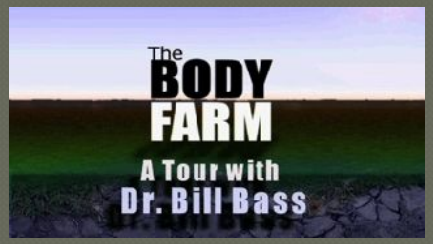
Images: Top Right - http://www.insectinvestigations.com/aboutfe.htm, Chart - http://www.clt.uwa.edu.au/__data/page/112507/fse07_forensic_entomology.pdf

Weather data is also an important tool in analyzing insect evidence from a corpse. Investigators will make note of the temperature of the **air**, **ground** surface, the **interface area** between the body and the ground, and the **soil** under the body as well as the temperature inside any **maggot masses**. They will also collect weather data related to daily **temperature** (highs/lows) and **precipitation** for a period of time before the body was discovered to the time the insect evidence was collected.

Other factors that might affect their PMI estimates:

1. Was the body enclosed in an area or wrapped in a material that would have prevented flies from finding the corpse and laying eggs?
2. Were other insect species present that may have affected the development of the collected species?
3. Were there drugs or other poisons in or on the body that might have affected the larvae's development?

Did you know…
The "Body Farm" in Knoxville, Tennessee is a university research facility to investigate human decomposition under various conditions in order to understand the factors which affect its rate.



Click the image to view a video about the Body Farm!

Blow Fly Metamorphosis

Blow flies are attracted to dead bodies and often arrive within minutes of the death of an animal. They have a **complete** life cycle that consists of **egg**, **larva**, **pupa**, and **adult** stages.

1st – Adult flies lay **eggs** on the carcass especially at wound areas or around the openings in the body such as the nose, eyes, ears, anus, etc.

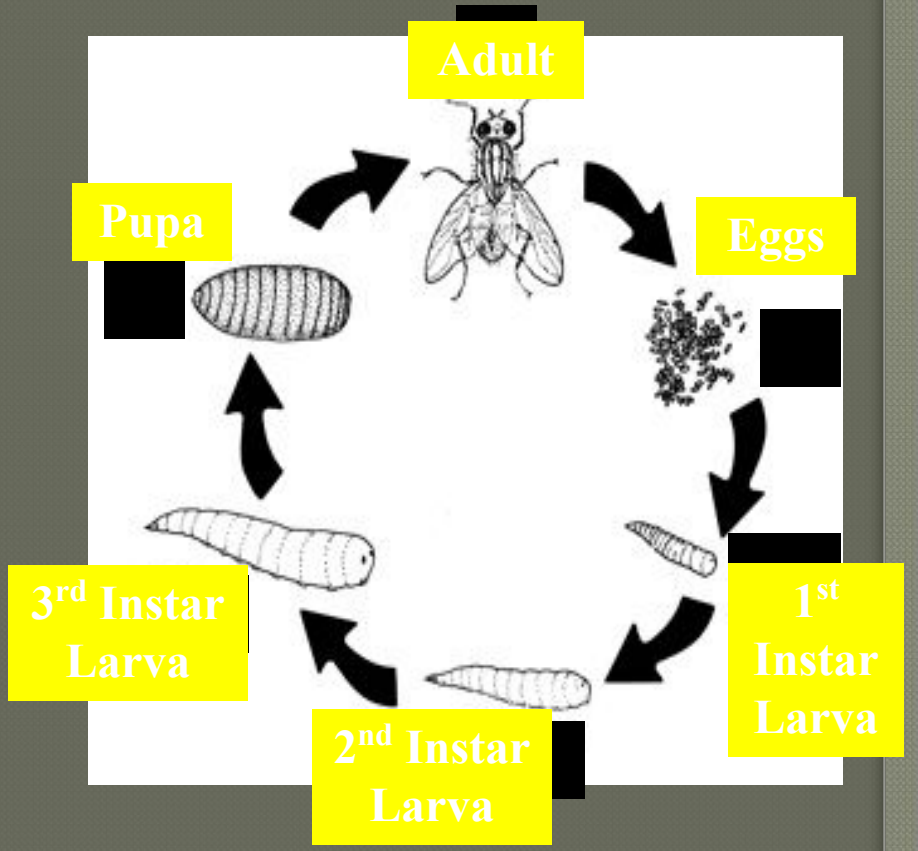
2nd – Eggs hatch into **larva** (maggots) in 12-24 hours.

3rd– Larvae continue to grow and **molt** (shed their exoskeletons) as they pass through the various instar stages.

- 1st Instar - 5 mm long after 1.8 days
- 2nd Instar - 10 mm long after 2.5 days
- 3rd Instar – 14-16 mm long after 4-5 days

4th – The larvae (17 mm) develop into pupa after burrowing in surrounding soil.

5th – **Adult** flies emerge from pupa cases after 6-8 days.



It takes approximately 14-16 days from egg to adult depending on the temperatures and humidity levels at the location of the body.

Image: http://www.umext.maine.edu/images/FlyLife.jpg
Information: http://www.kathyreichs.com/entomology.htm and http://www.forensicentomologist.org/

Examples of Diptera (Flies)

Early Stage Decomposition

Life Cycle of a Calliphoridae Fly

Blow & Greenbottle Flies (Calliphoridae)
Metallic thorax and abdomen

Flesh Fly (Sarcophagidae)
Striped thorax

Late Stage Decomposition

House Fly (Muscidae)

Cheese Skipper (Piophilidae)

Informational Source: http://naturalsciences.org/files/documents/csi_tg_overview.doc
Images: Top Left - http://www.scienceinschool.org/repository/images/issue2forensic3_large.jpg, Middle-Left: http://forensicfact.files.wordpress.com/2008/04/blowfly053.jpg,
Top Right - http://users.usachoice.net/~swb/forensics/P1.jpg, Bottom - http://www.deathonline.net/decomposition/corpse_fauna/flies/index.htm

Examples of Coleoptera (Beetles)

Early Stage Decomposition


Carrion Beetles (*Silphidae*)
Adults & larvae feed on fly larvae

Early to Late Stage Decomposition

Rove Beetles (*Staphylinidae*)
Predator of fly eggs

Clown Beetles (*Histeridae*)
Predator of fly eggs

Late Stage Decomposition

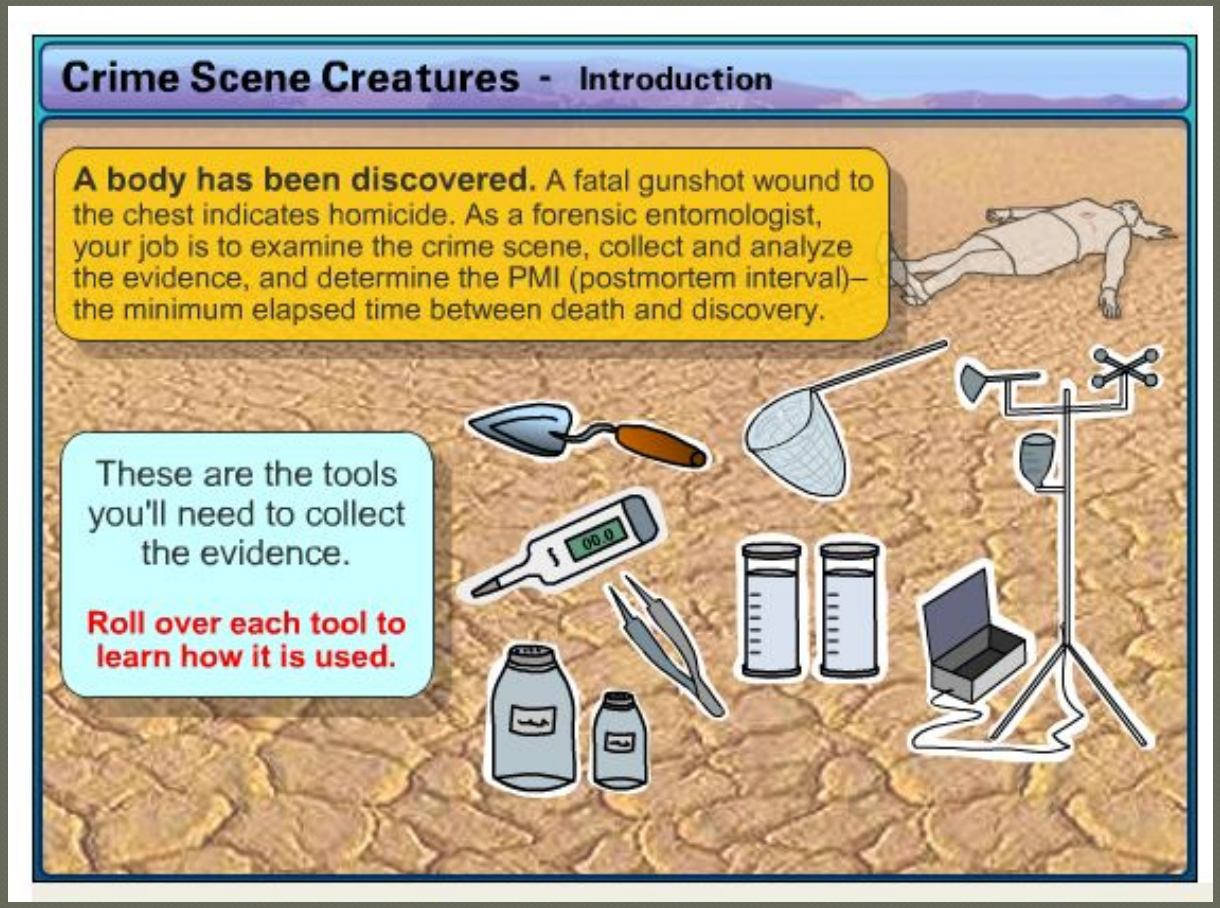
Ham & Checkered Beetles (*Cleridae*)
Predator of flies & beetles; also feed on dead tissue

Skin Beetles (*Dermestidae*)
Feed on dried skin & tissues


Hide Beetles (*Scarabidae*)
Usually the last to arrive

Informational Source: http://naturalsciences.org/files/documents/csi_tg_overview.doc
Images: http://www.cals.ncsu.edu/course/ent425/library/spotid/coleoptera/coleoptera.html & http://www.forensicflies.com/beetles.htm

Let's give it a try …



Click the image above or click here to visit the website at
http://www.pbs.org/wnet/nature/episodes/crime-scene-creatures/interactive-determine-the-time-of-death/4390/

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ADD Theory

Added Daily Degree

ADD

- Added Daily Degree is used to estimate the PMI by
  - Comparing the amount of heat the insect must accumulated (add) to reach various stages of its life cycle
  - Scientists must either find the comparison data or perform tests on the larvae to determine this information.

How Does This Work?

- You must find the high and low temperature for the day you find the body and then for about 10 days before.
- Calculate a mean temperature for each day.
- Then you subtract 6^0C, this is an adjustment for the insect developmental threshold.
- Then you add the adjusted temperature to the ADD.