The Biodiversity of Medical, Veterinary and Forensic Importance Flies in Malaysia

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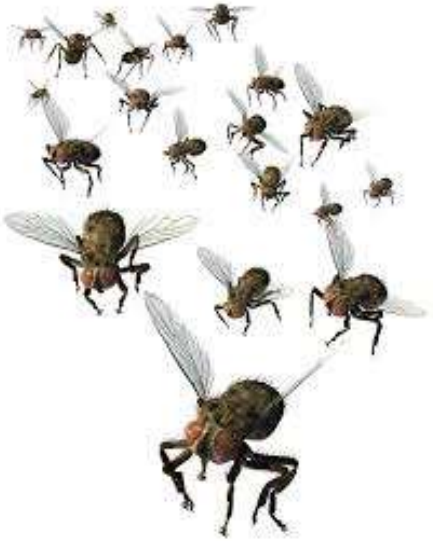
Content

- Introduction of Diptera
- Medical Importance Diptera
- Veterinary Importance Diptera
- Forensic Importance Diptera
- Conclusion

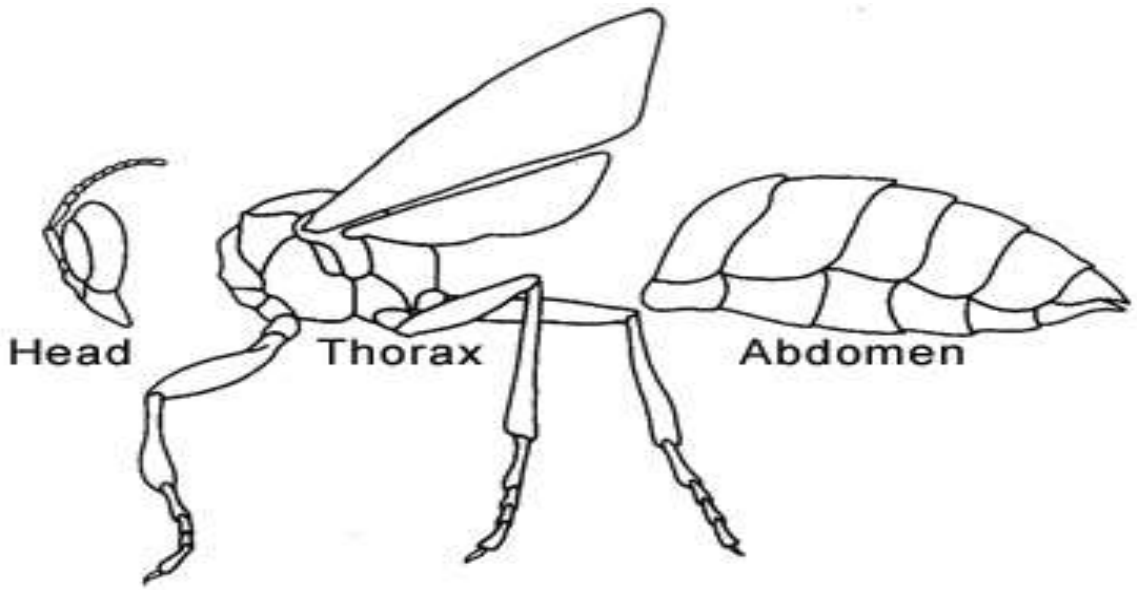


What is Entomology?

What is Entomology?

- **Entomology** is the **scientific study of insects and arthropods**

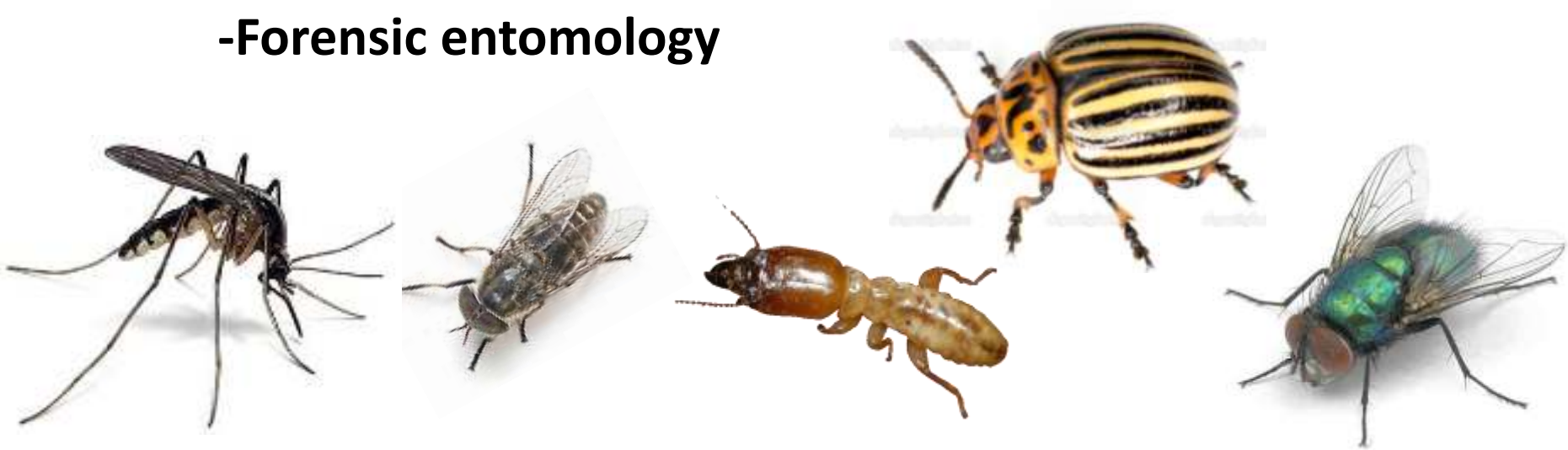
  (Greek: *Entomos* = cut in pieces; *logia* = study)



Different Types of Entomology

- Entomology can be further divided into different subfields such as

-Medical entomology
-Veterinary entomology
-Urban entomology,
-Agricultural entomology
-Forensic entomology



Medical Entomology

sand flies

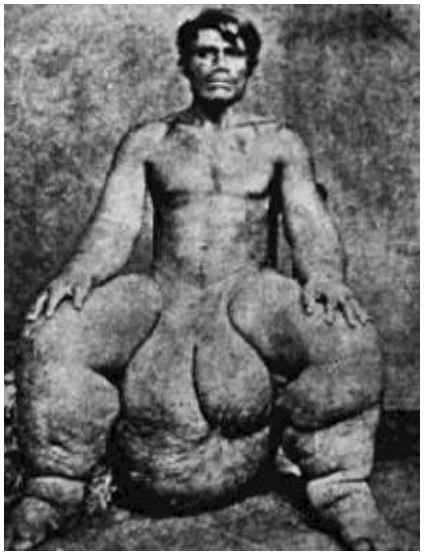
↓

Kala-azar

mosquitoes

↓

elephantiasis



kissing bugs

↓

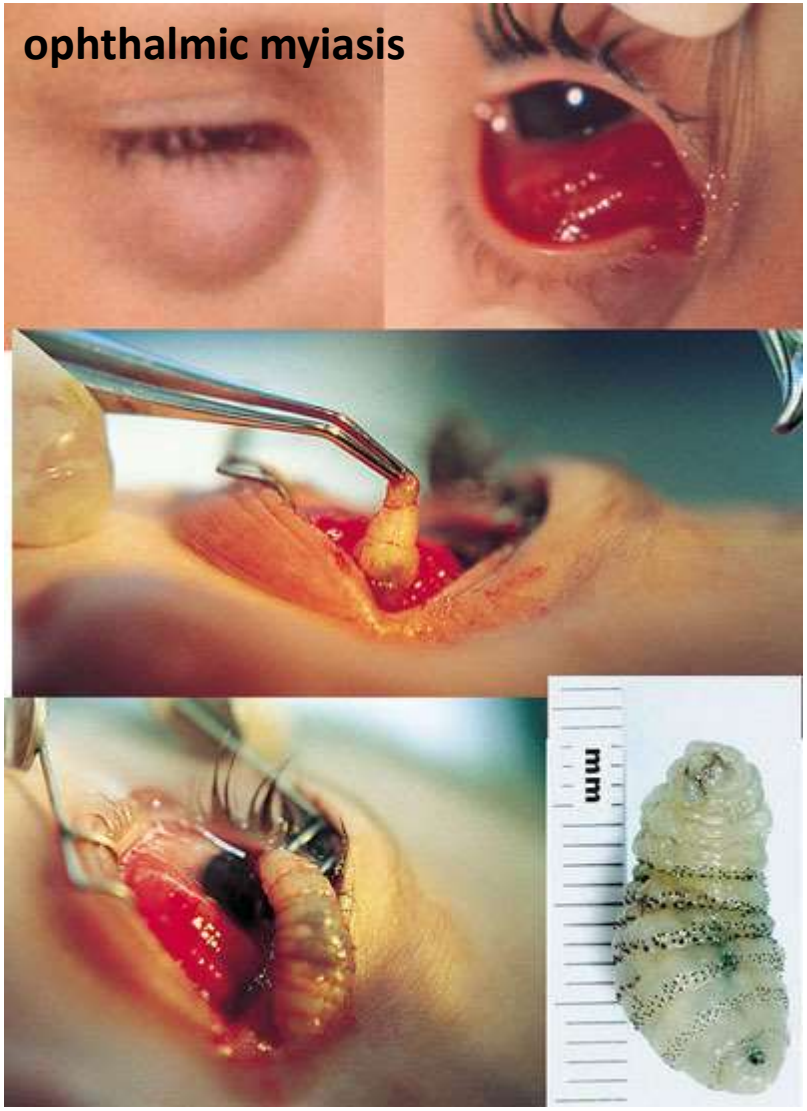
Chagas disease

tsetse flies

↓

Sleeping sickness

Myiasis



Reported Cases of Human Myiasis in Malaysia

Type of myiasis	Causative agent	Reference
Dermal	*Chrysomya bezziana*	Reid, 1953
Intestinal	*Sarcophaga* spp.	Cheong et al. 1973
Intestinal	N/A	Baharudin et al. 1973
Intestinal	*Clogmia albipunctatus*	Smith & Thomas, 1979
Urogenital	*C. bezziana*	Ramalingam et al. 1980
Dermal	*Sarcophaga krameri*	Thomas et al. 11980
Dermal	N/A	Ramalingam, 1982
Dermal	*C. bezziana, C. megacephala*	Abu Baker et al. 1984
Oral	*C. bezziana*	Lee, 1985
Urogenital	N/A	Lee, 1989
Aural	*C. megacephala*	Lee & Yong, 1991
Aural	*C. bezziana*	Johari & Khanijow, 1993
Intestinal	*Hermetia illucens*	Lee et al. 1995
Oral	N/A	Roszalina & Rosalan, 2002
Aural	*C. bezziana*	Rohela et al. 2006
Aural	Sarcophagidae spp	Nazni et al. 2009
Dermal	*Chrysomya spp.*	Rahoma & Latif, 2010
Intestinal	*Clogmia albipunctatus*	Mokhtar et al. 2016

Bee sting

Bed bugs infestation

Veterinary Entomology








Urban Entomology

silverfish infestation

termites infestation

Urban Entomology

Agricultural Entomology

What is Forensic Entomology?

Forensic entomology is the use of **insect evidence** to answer question pertaining to **legal issues**

(Catts & Haskell 1990)

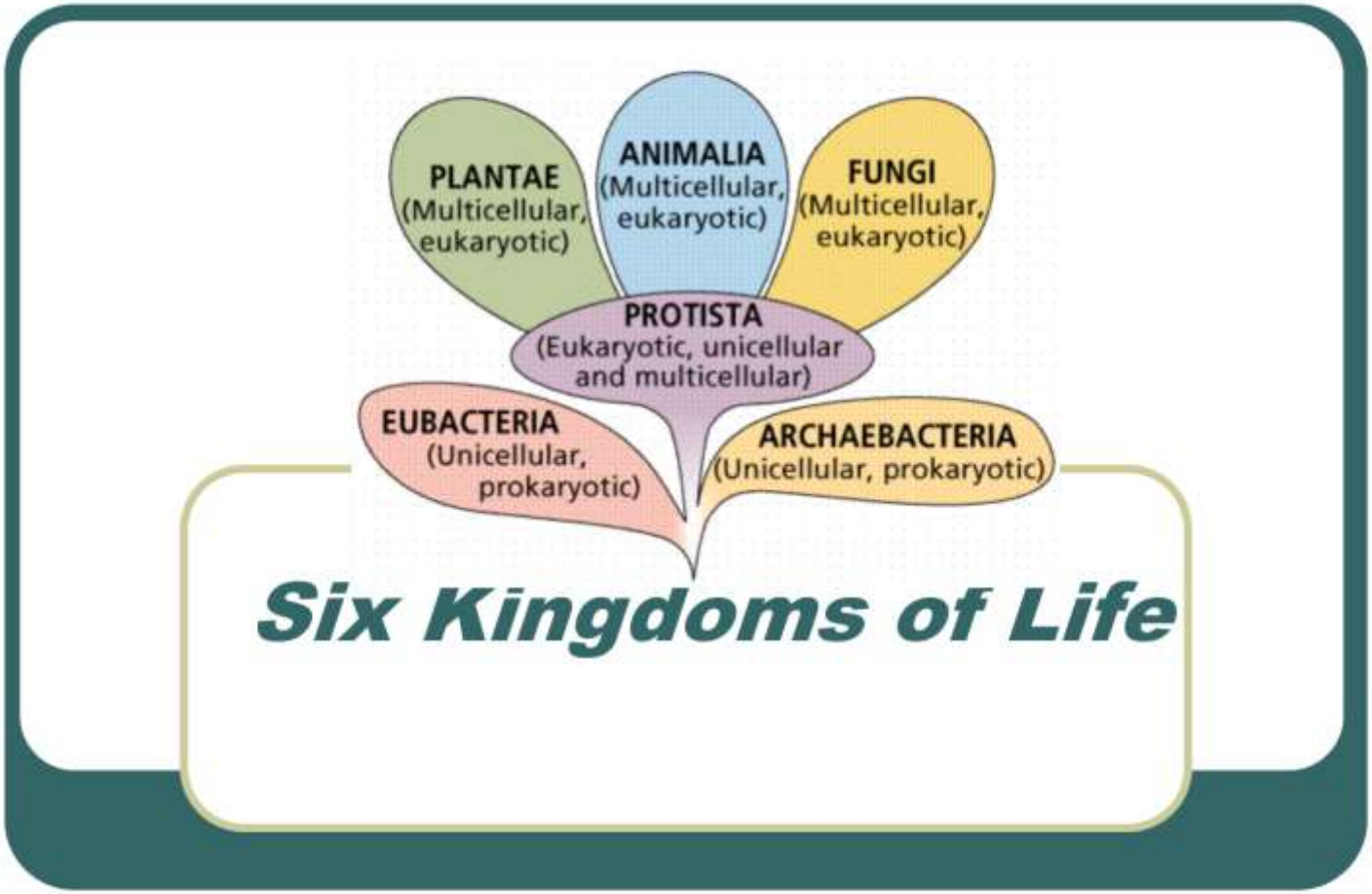
Medicolegal Entomology

Include arthropods involvement in events such as **murder, suicide, rape, physical abuse, contraband trafficking** and **movement of body**.

(Byrd & Castner 2000)

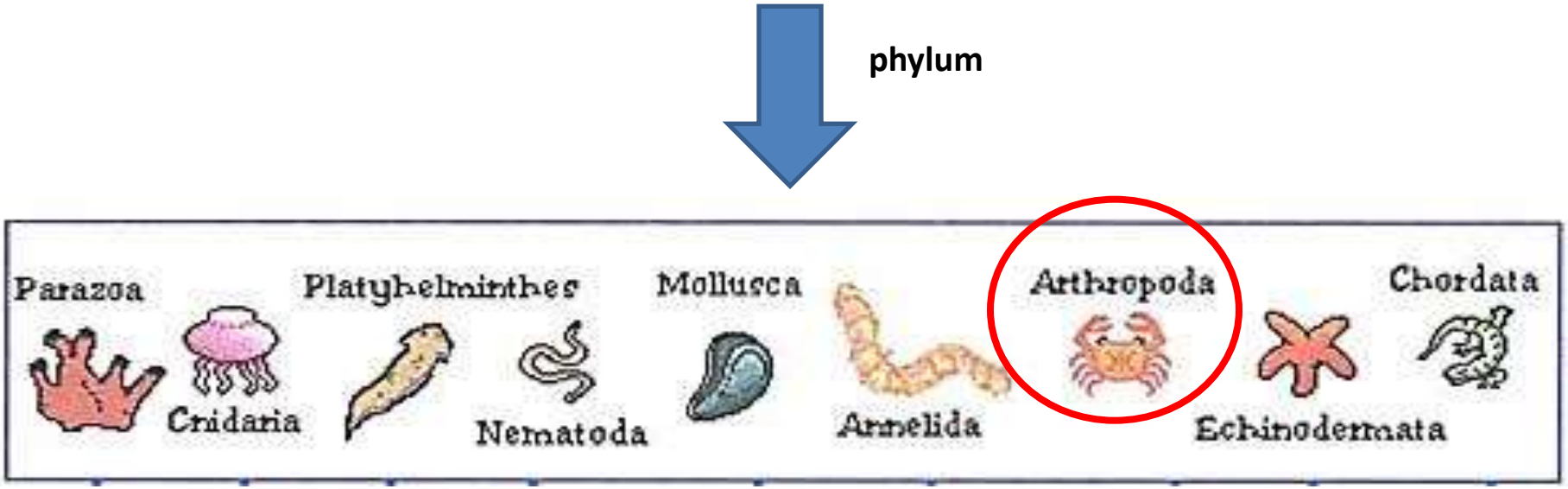
What are Flies?

Basic Classification of Life



http://www.docstoc.com/docs/73427661/Six-Kingdoms-of-Life

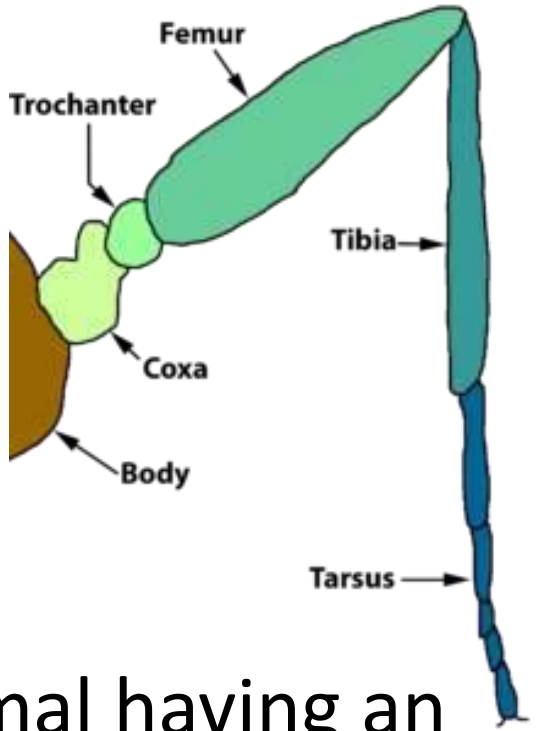
Kingdom Animalia



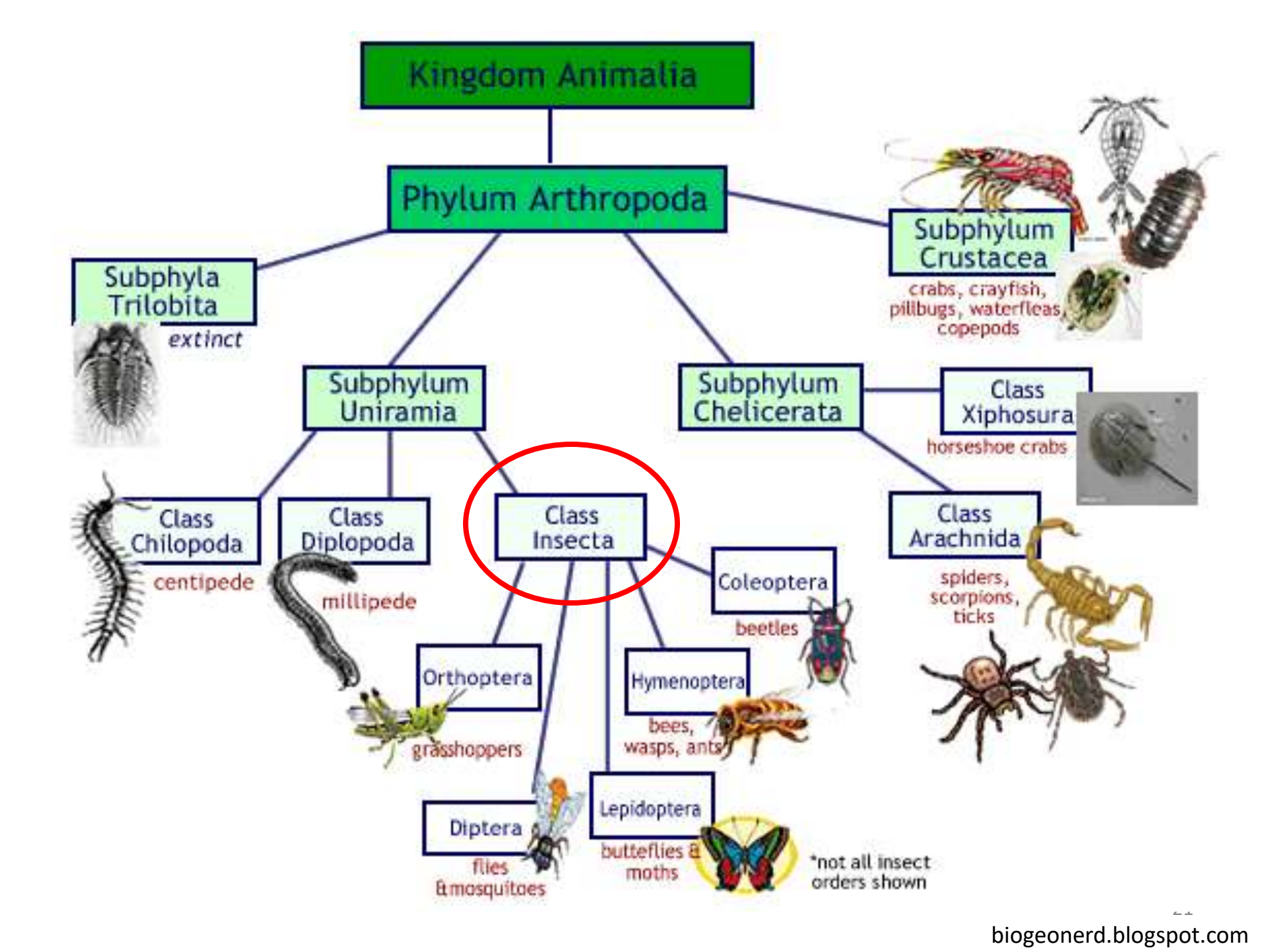
Introduction to Arthropoda

- **Arthropods** from the Greek:

  Arthros = jointed; *poda* = foot

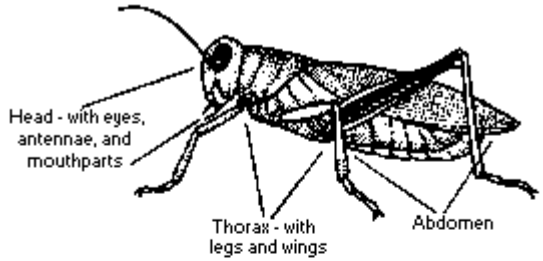


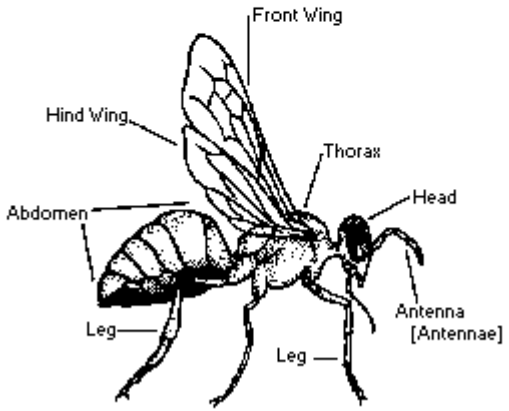
- **Arthropod** is an **invertebrate** animal having an **external skeleton**, **segmented body** and **jointed appendages**



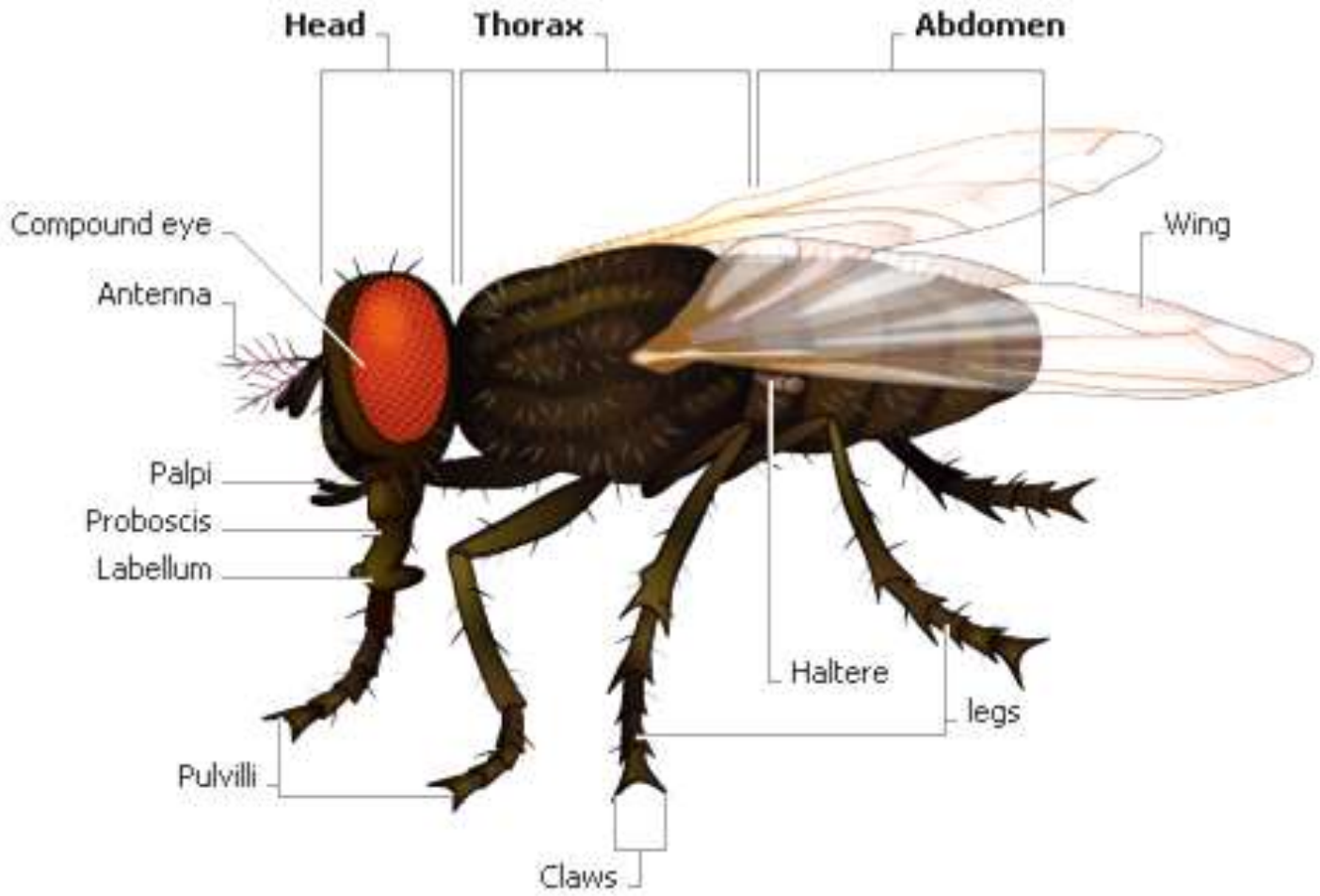
General Features of Insecta

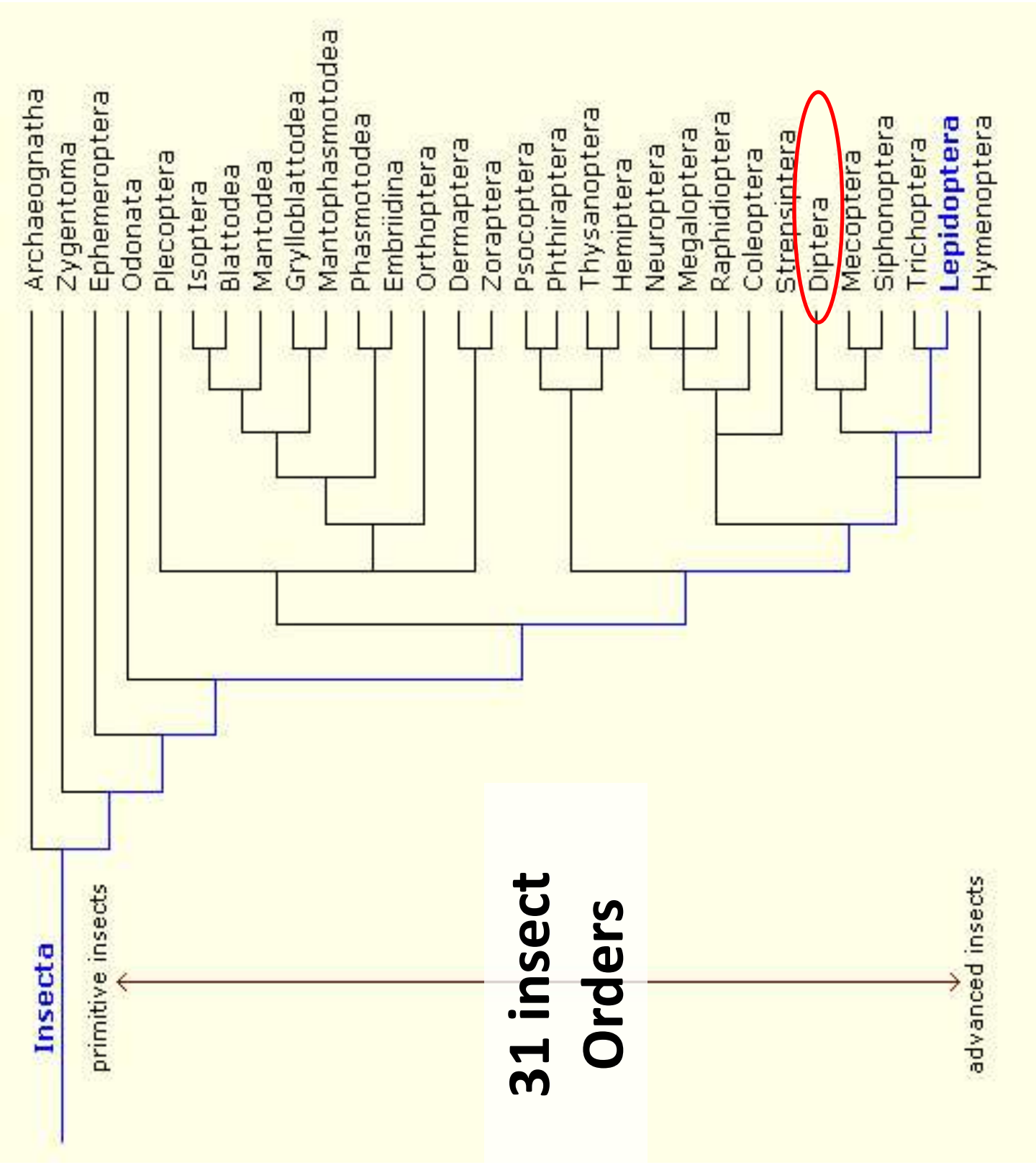
- **Head, thorax and abdomen**
- **Three pairs** of legs
- **One pair** of segmented **antenna**
- **One or two pairs** of **wings**
- **Compound eyes**





Anatomy of a Fly

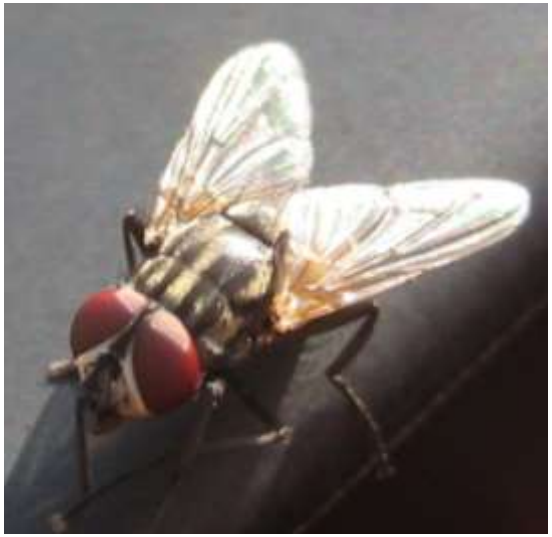



Archaeognatha
Zygentoma
Ephemeroptera
Odonata
Plecoptera
Isoptera
Blattodea
Mantodea
Grylloblattodea
Mantophasmotodea
Phasmotodea
Embriidina
Orthoptera
Dermaptera
Zoraptera
Psocoptera
Phthiraptera
Thysanoptera
Hemiptera
Neuroptera
Megaloptera
Raphidioptera
Coleoptera
Strepsiptera
Diptera
Mecoptera
Siphonoptera
Trichoptera
Lepidoptera
Hymenoptera
Insecta
primitive insects
advanced insects
31 insect Orders

Diptera

- Common name: **flies**
- Greek “di = **two**”, and “ptera = **wings**”
- **Transmit diseases** (biologically or mechanically) and **cause diseases**
- **Holometabolous** life cycle
- **Two wings** and one pair of **halteres**

Hierarchy of Biological Classification



Common house fly

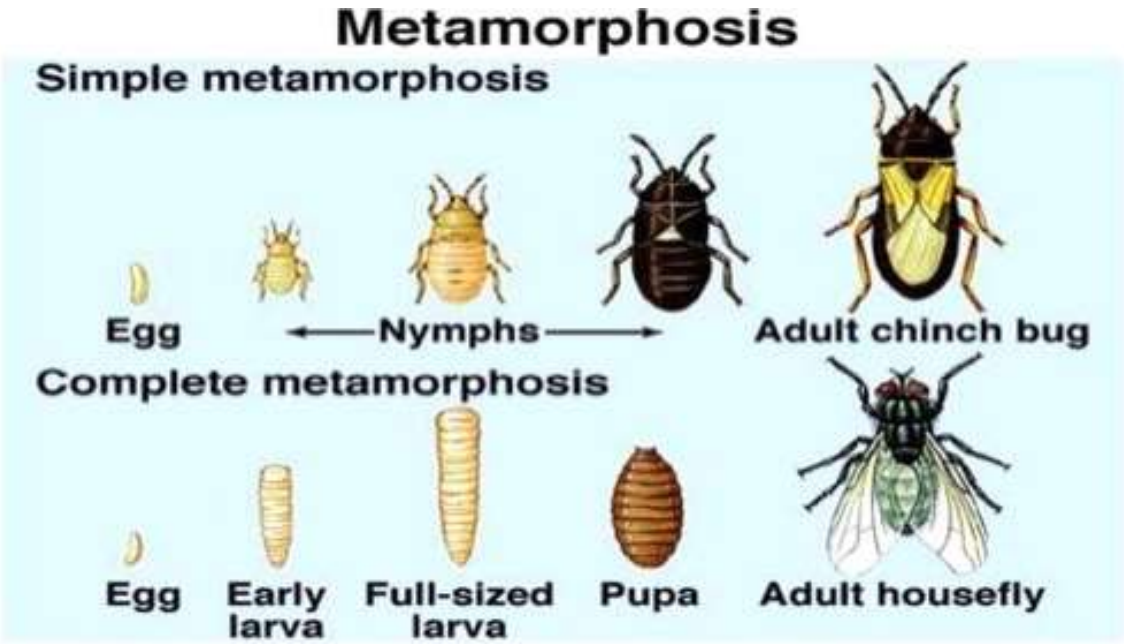
Musca domestica **Linnaeus, 1758**

Musca domestica

Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Diptera
	Muscidae
	Musca
	domestica

Life Cycle of Insects

- **Holometabolous**
- **Hemimetabolous**



Holometabolous

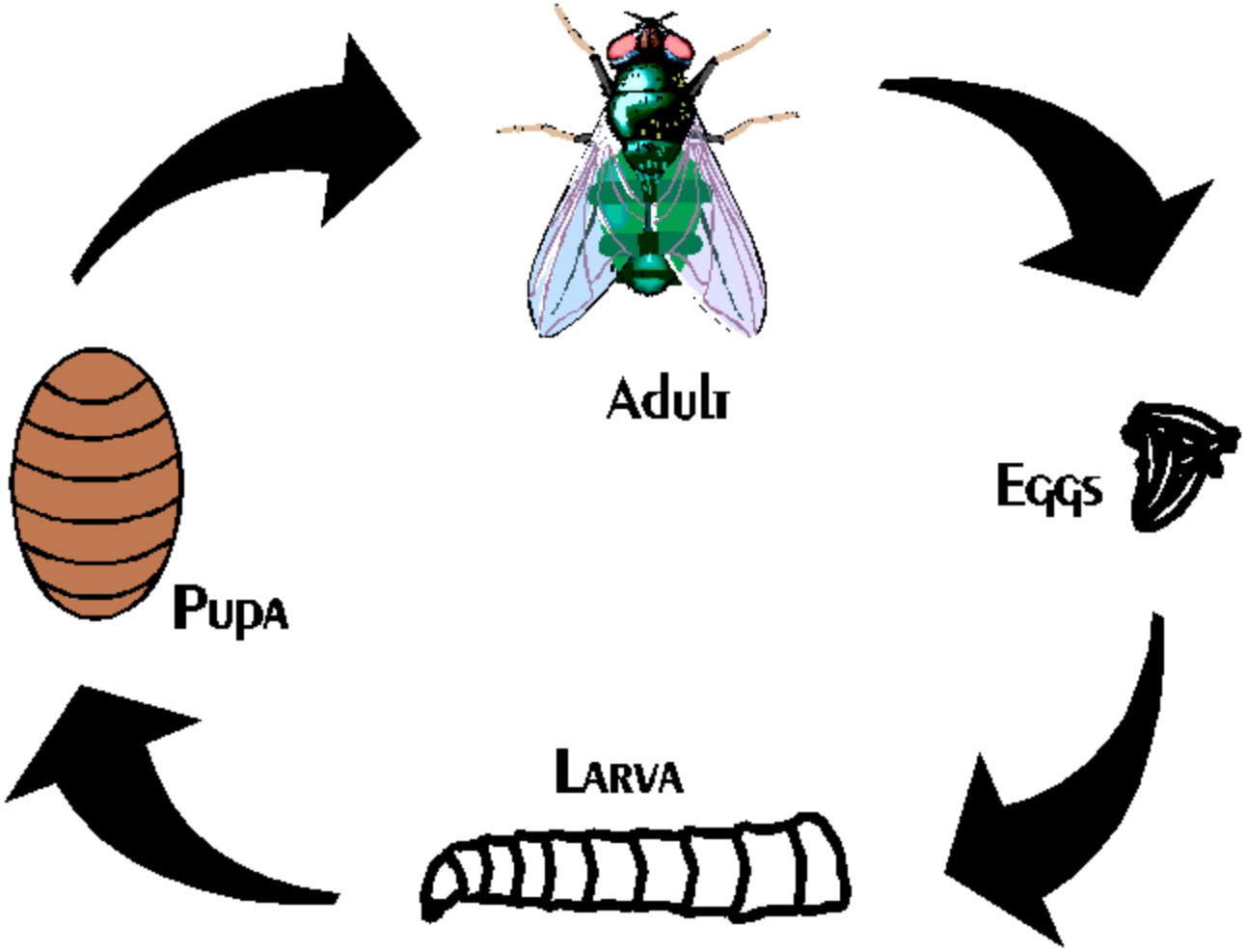
- **Complete life cycle/complete metamorphosis**

- From **egg** ⇒ **larva** ⇒ **pupa** ⇒ **adult**




- Example: **mosquitoes, flies, fleas, beetles, moths**

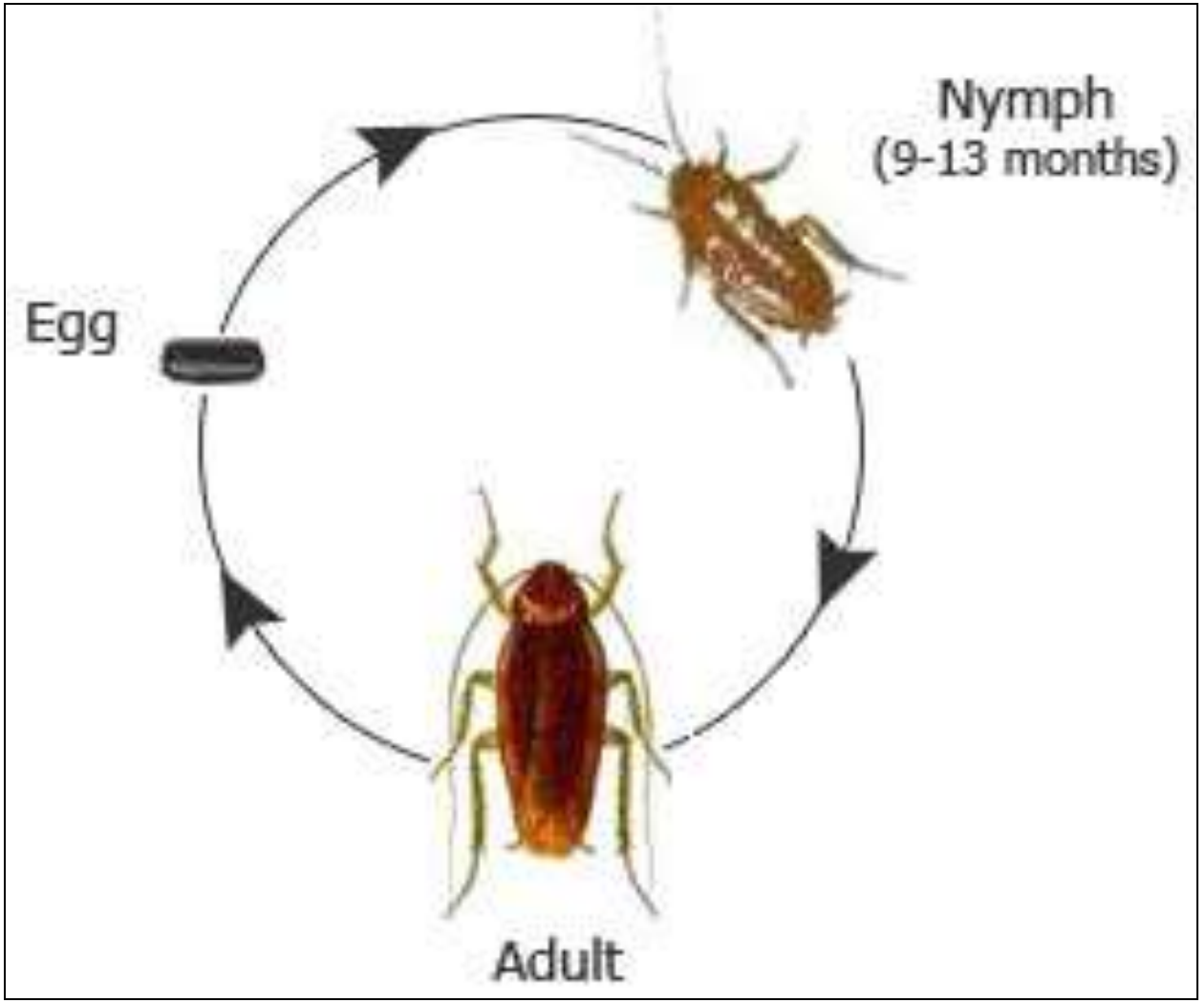
Life Cycle of Flies - Holometabolous



Hemimetabolous

- **Incomplete metamorphosis / incomplete life cycle**
- There is **no pupa stage**
- From **egg** → **nymph** → **adult**
- Example: **lice, bugs, cockroaches**

Life Cycle of Cockroaches- Hemimetabolous

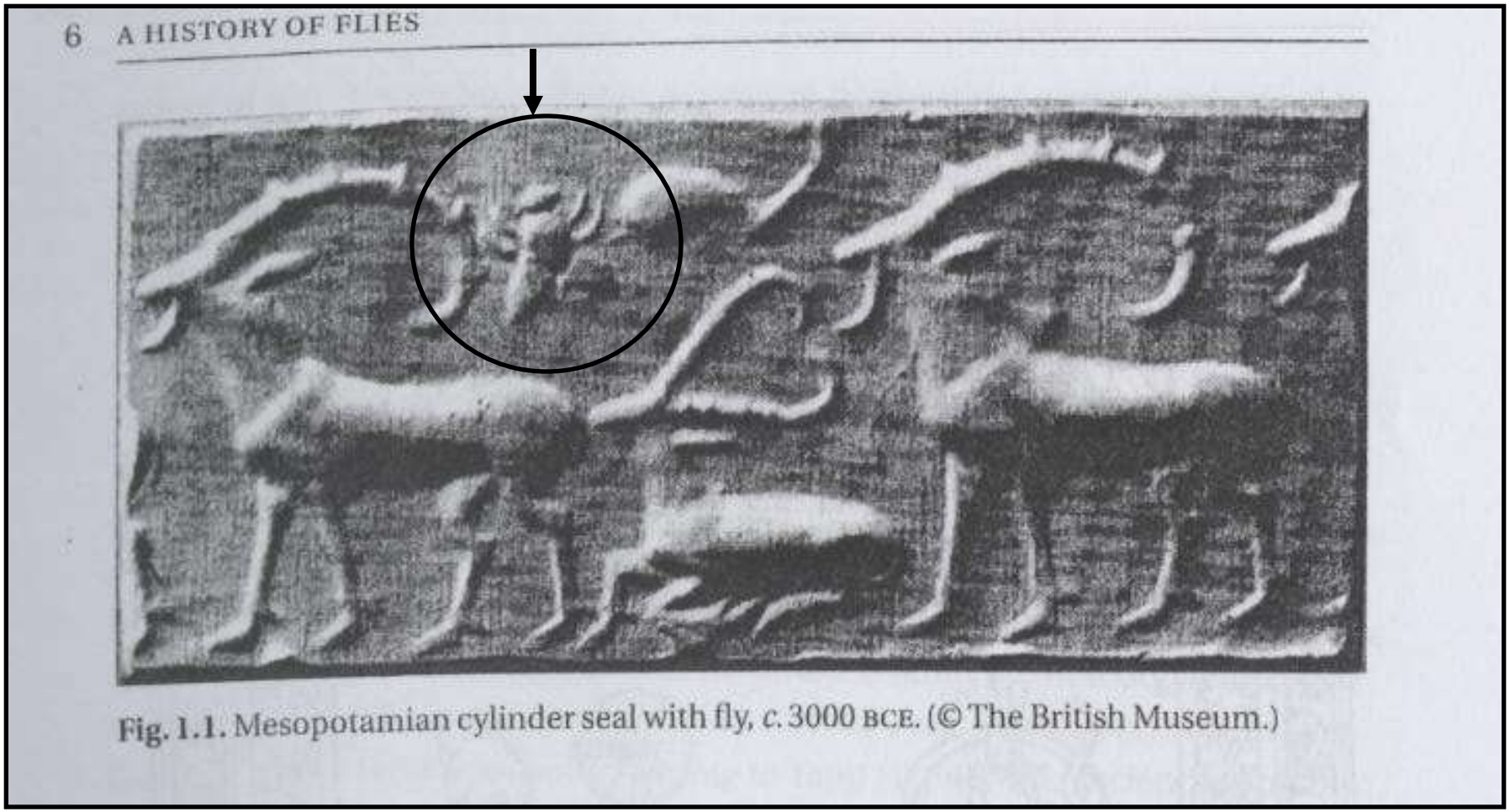


A History of Flies

Chrysomya villeneuvi Patton,1922

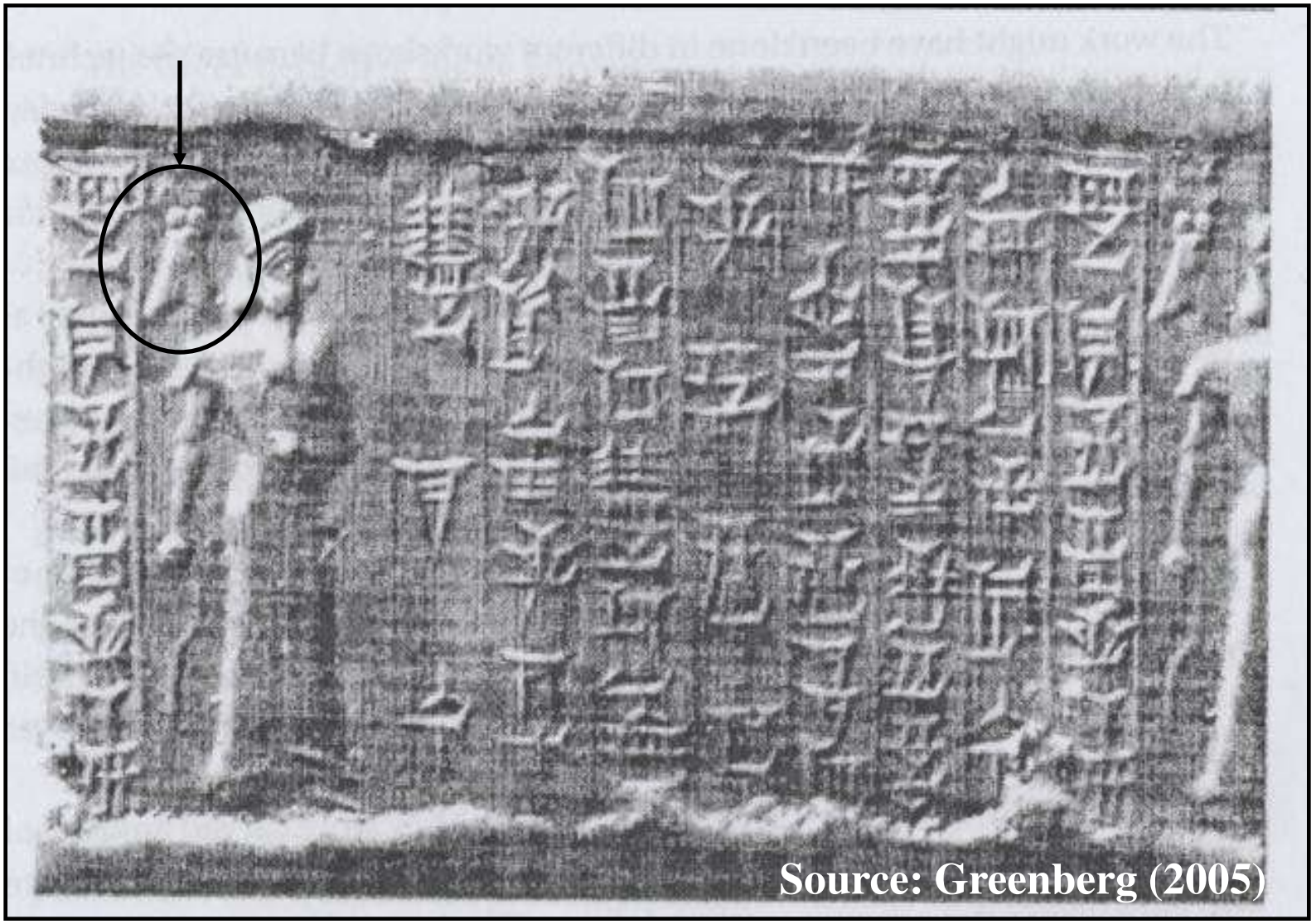
Heo CC 2008

Mesopotamia cylinder seal with FLY – 3000 BC



Source: Greenberg (2005)

Cylinder seal with FLY and the god Nergal
Old Babylonian 1700-1400 BC



Flies of gold- Awarded by **Queen Ahotep** to a **brave Egyptian** soldier

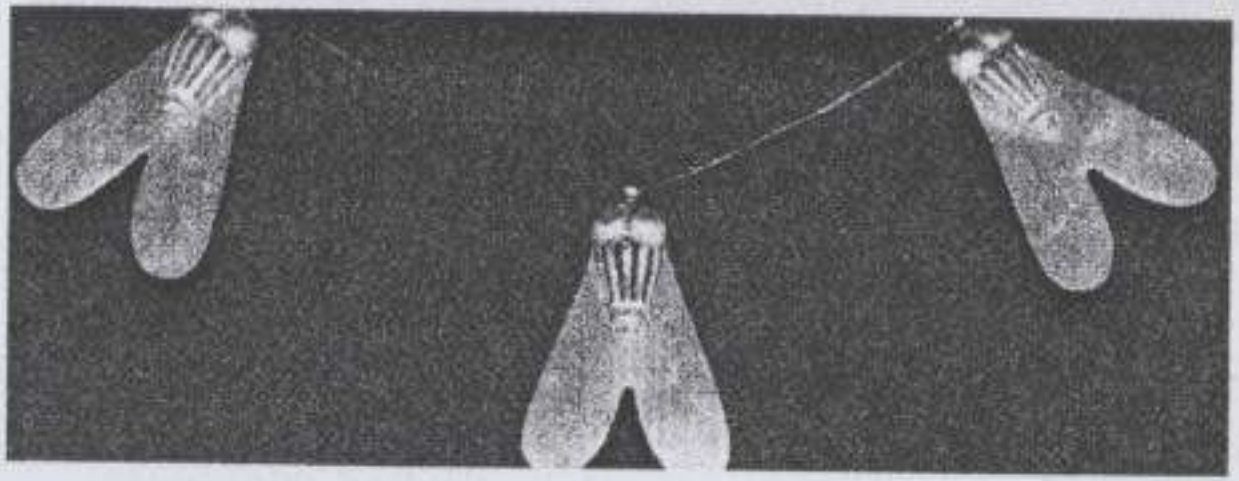


Plate 3
Flies of gold, probably the common housefly, *Musca domestica* or the eye fly, *Musca sorbens*. Awarded by Queen Ahotep to a brave Egyptian soldier.

Source: Greenberg (2005)

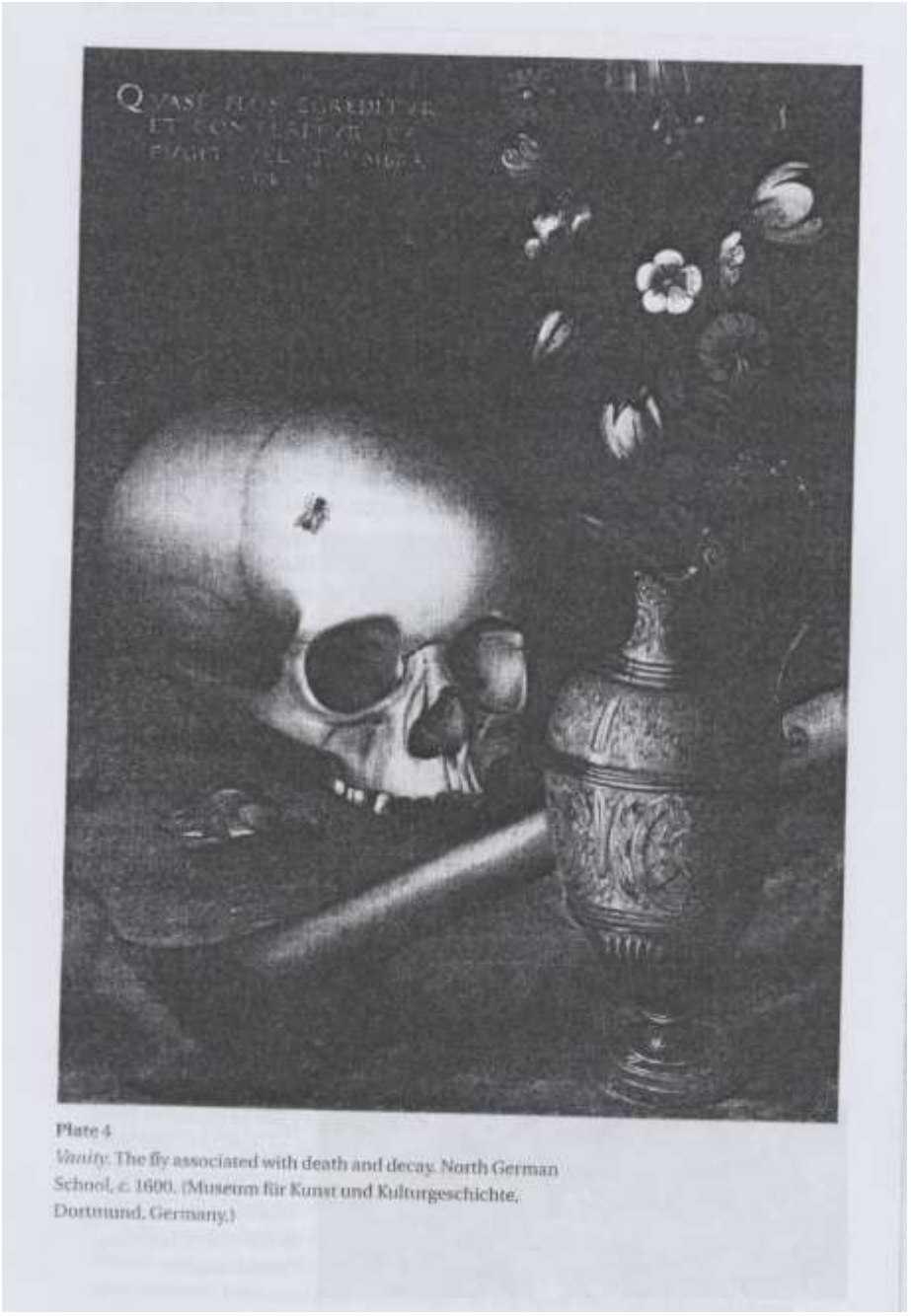
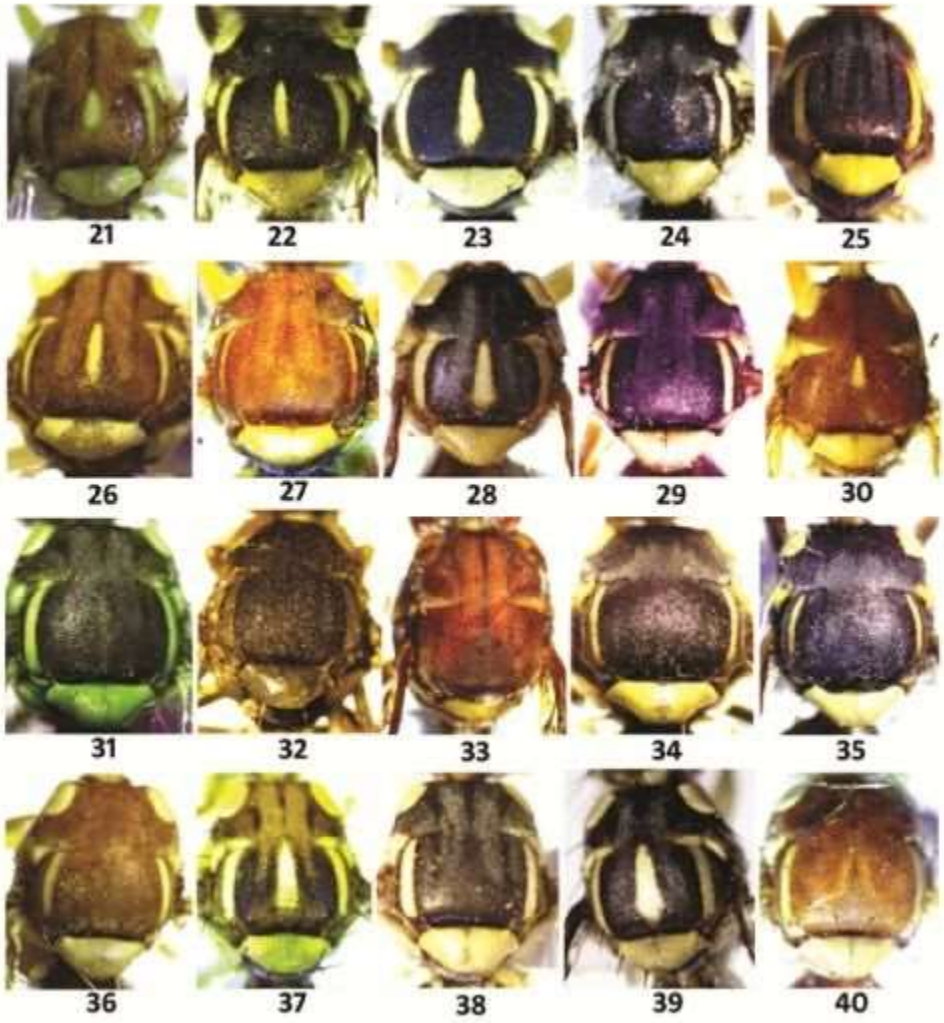


Plate 4
Vanity. The fly associated with death and decay. North German School, *c.* 1600. (Museum für Kunst und Kulturgeschichte, Dortmund, Germany.)

Fly is associated with death and decay

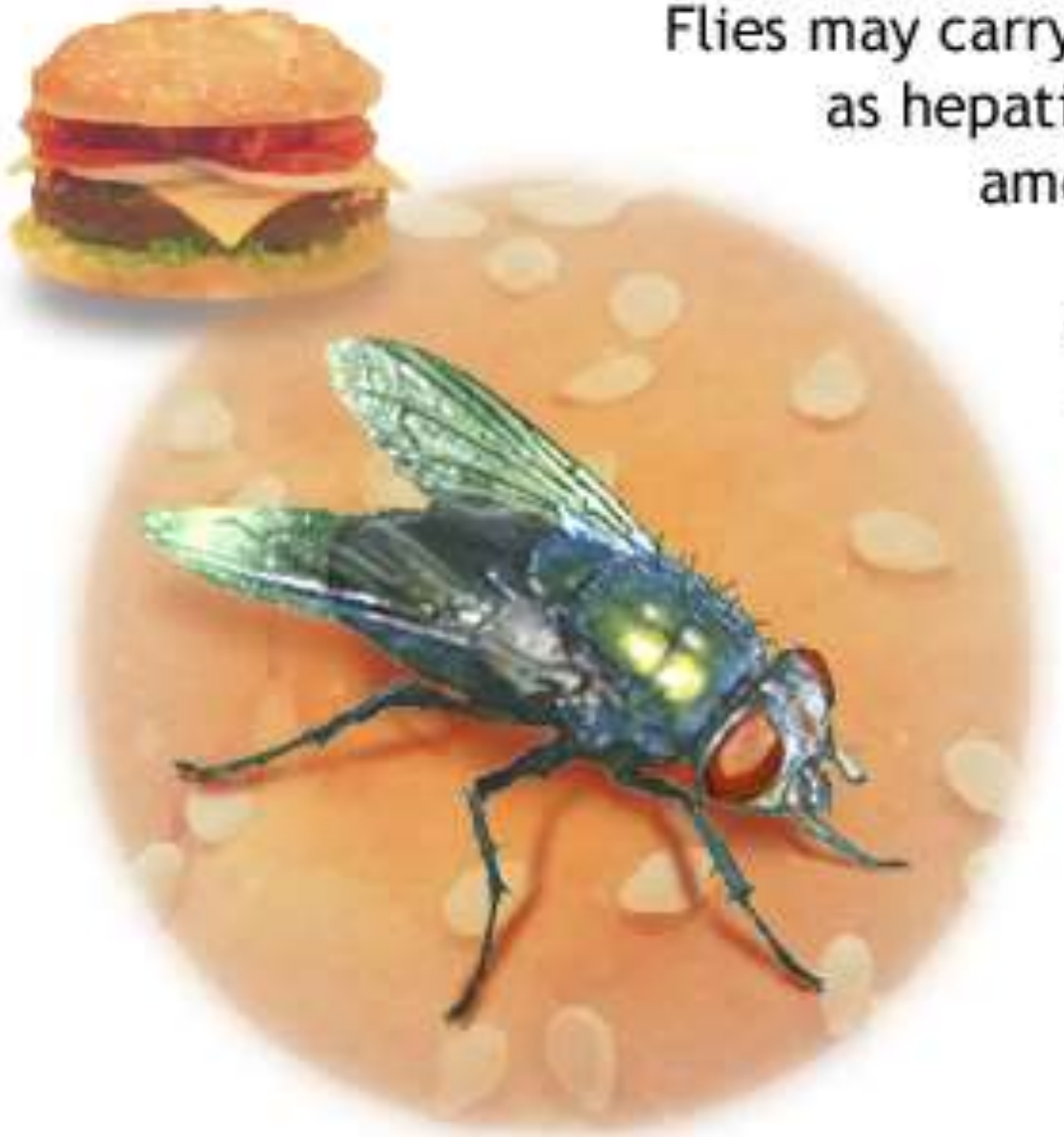
Vanity, North German School, 1600

Diversity of Flies in Malaysia



Medically Important Flies in Malaysia

- *Musca domestica*
- *Musca sorbens*
- *Chrysomya megacephala*
- *Chrysomya bezziana*
- *Chrysomya rufifacies*
- *Lucilia cuprina*
- *Megaselia scalaris*
- *Hermetia illucens*
- *Fannia* spp.
- *Drosophila* spp.



Flies may carry diseases such as hepatitis A, typhoid, amebic dysentery and polio by contaminating food or water

A.D.A.M.

Veterinary Importance Flies in Malaysia

- *Musca domestica*
- *Musca sorbens*
- *Musca crassirostris*
- *Musca ventrosa*
- *Musca inferior*
- *Stomoxys calcitrans*
- *Tabanus* spp.
- *Haematobia* spp.

Forensically Important Diptera in Malaysia

- **Calliphoridae**
  - *Chrysomya megacephala*
  - *Chrysomya rufifacies*
  - *Chrysomya bezziana*
  - *Chrysomya pinguis*
  - *Chrysomya villeneuvi*
  - *Chrysomya chani*
  - *Chrysomya nigripes*
  - *Hemipyrellia ligurriens*
  - *Hypopygiopsis violacea*
- **Muscidae**
  - *Synthesiomyia nudiseta*
  - *Hydrotaea spinigera*
- **Sarcophagidae**
  - *Boettcherisca peregrina*
  - *Parasarcophaga dux*
  - *Parasarcophaga ruficornis*
- **Fanniidae**
  - *Fannia canicularis*
- **Stratiomyidae**
  - *Hermetia illucens*
- **Piophilidae**
  - *Piophila* spp.
- **Syrphidae**
  - *Eristalis* spp.
  - *Eristalinus* spp.
- **Phoridae**
  - *Megaselia* spp.

JOURNAL OF FORENSIC SCIENCES

Technical Note

Eristalinus arvorum (Fabricius, 1787) (Diptera: Syrphidae) in Human Skull: A New Fly Species of Forensic Importance†

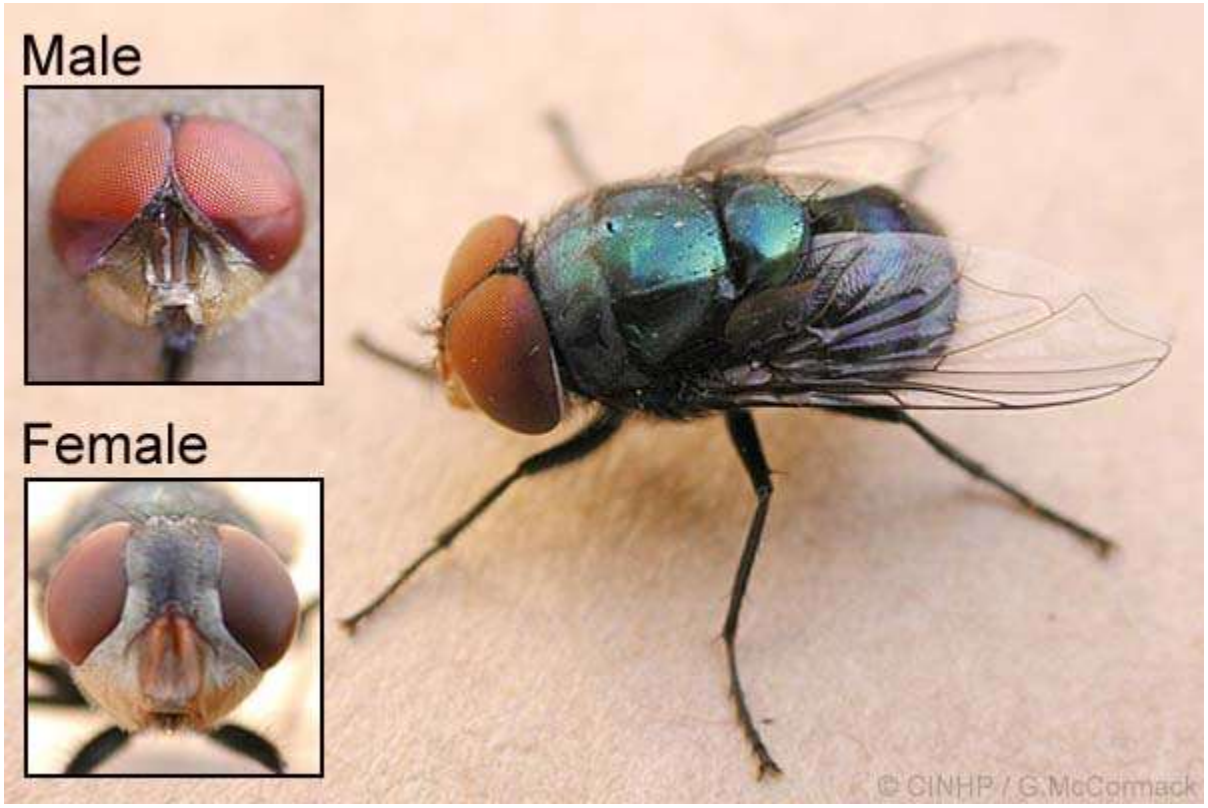
Chong Chin Heo Ph.D., Razuin Rahimi M.Path Forensic., Ximo Mengual Ph.D., Mohd. Shahirul M. Isa B.S., Syameem Zainal B.S., Putri Nabihah Khofar B.S., Wasi Ahmad Nazni Ph.D.

First published: 15 July 2019 | https://doi.org/10.1111/1556-4029.14128

† Presented at the Mid-Year Seminar of the Forensic Science Society of Malaysia (FSSM), March 7, 2018, in Kuala Lumpur, Malaysia; and at the 55th Annual Scientific Conference of the Malaysian Society of Parasitology and Tropical Medicine (MSPTM), March 13, 2019, in Kuala Lumpur, Malaysia.
‡ [Corrections added 17 July 2019. The Case Description was altered to remove specific location and coordinates, and the Acknowledgments section was replaced.]

Chrysomya megacephala

- Oriental latrine flies
- **Yellow gena**, dark prothoracic spiracle, no stripes on thorax

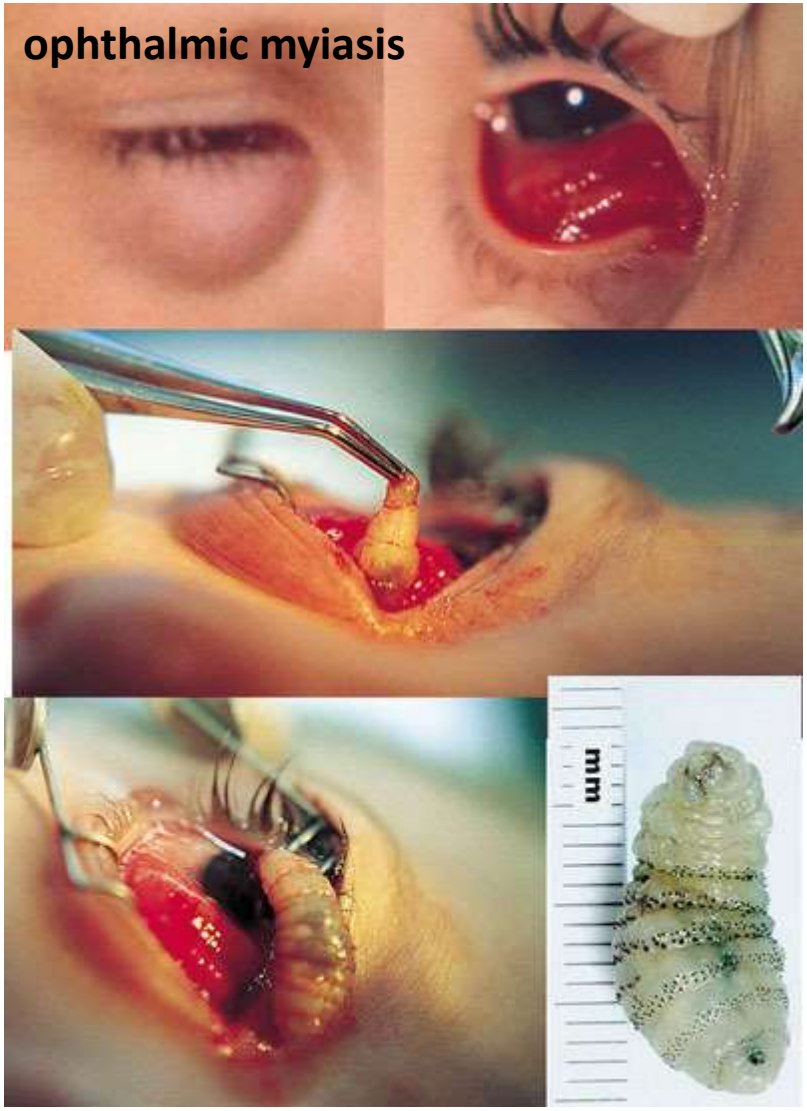


http://cookislands.bishopmuseum.org/species.asp?id=9197

Chrysomya bezziana

- **Obligatory** myiasis agent

Myiasis



Chrysomya rufifacies

- Known as **hairy maggot blow fly**
- **White gena**, white prothoracic spiracles, no stripes on thorax

Spot Identification

Chrysomya rufifacies

Chrysomya megacephala

Lucilia cuprina

- Australian sheep blow fly / bronze bottle fly
- **Warm weather species**
- Causes myiasis (but its larvae are useful in MDT in Asia)
- **Coppery color**, metallic green forefemora, 1 occipital setae

Muscidae

Musca domestica

***Hydrotaea* sp.**

Synthesiomyia nudiseta

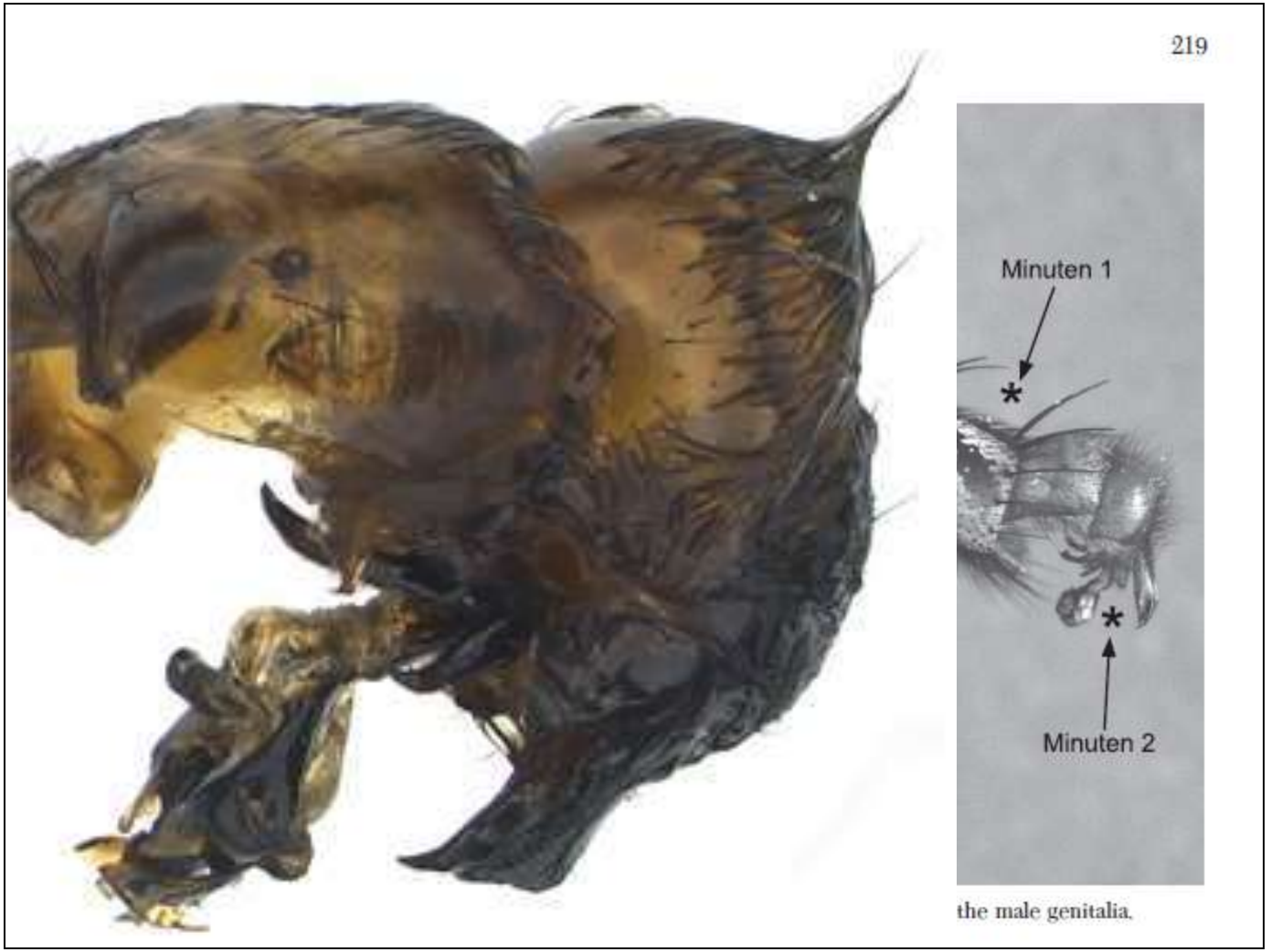
BugGuide.Net

Diptera.info

Sarcophagidae

- **Flesh flies**
- Warm weather
- Late comer to carrion (often after calliphorids)
- **Larviparous**
- **4 notoplural bristles**
- **Grey color, 3 dark stripes on thorax, checkered board abdoment**

Genitalia of flesh fly



Ovoviviparous

Heo CC (2012)

Phoridae

- Hump-backed flies / scuttle fly / coffin fly
- Thorax is **rounded** in appearance
- **Thickened costa vein, wing without cross veins**
- **Hind femora is laterally flattened**
- The larvae can be parasitic
- Infests buried remain

Fanniidae

Stratiomyidae

BugGuide.Net

Piophilidae

- Cheese-skipper
- Prefer **dry-remain** stage of decomposition

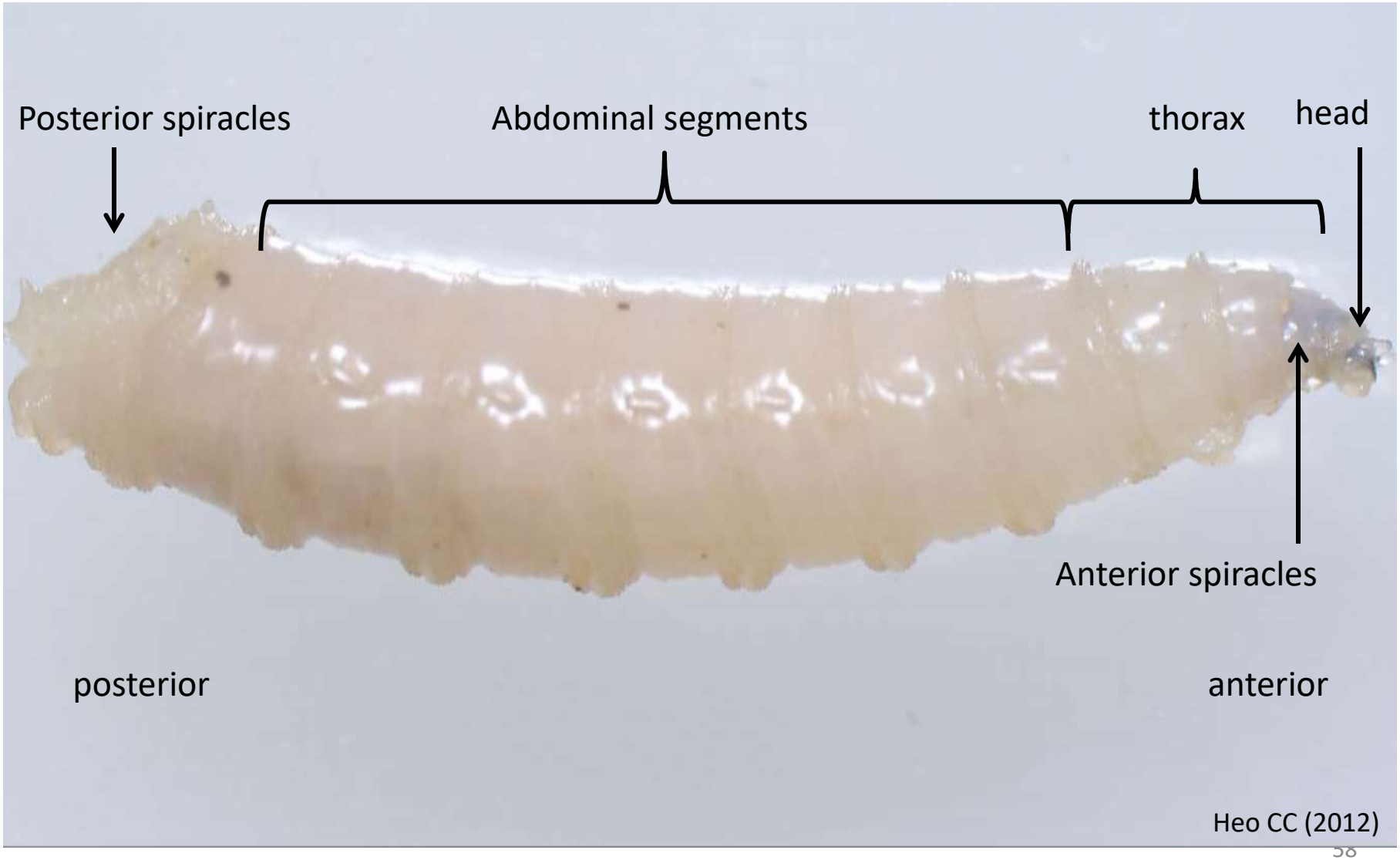
Piophilidae

- Cheese-skipper
- Prefer **dry-remain** stage of decomposition

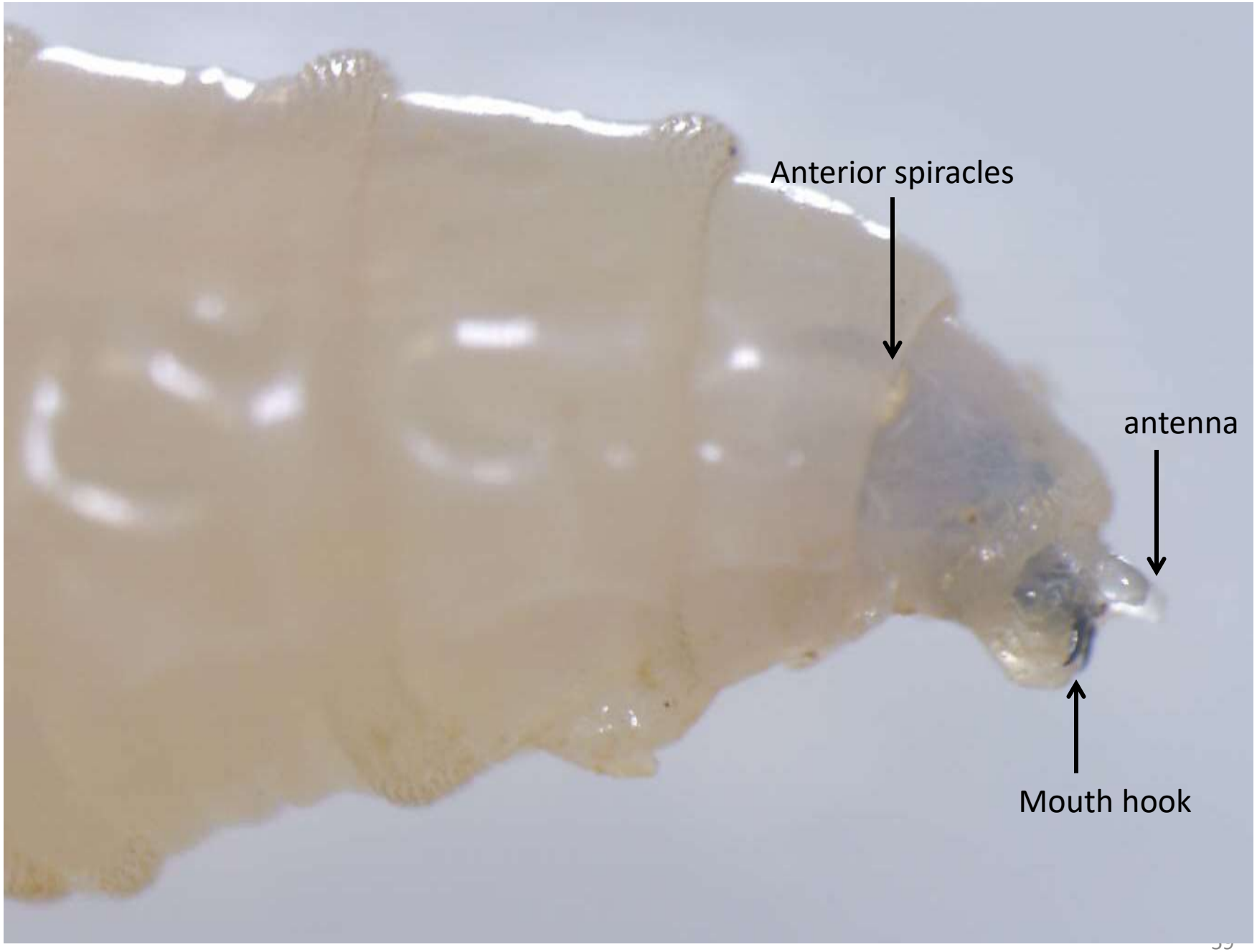
Piophilidae

- Cheese-skipper
- Prefer **dry-remain** stage of decomposition

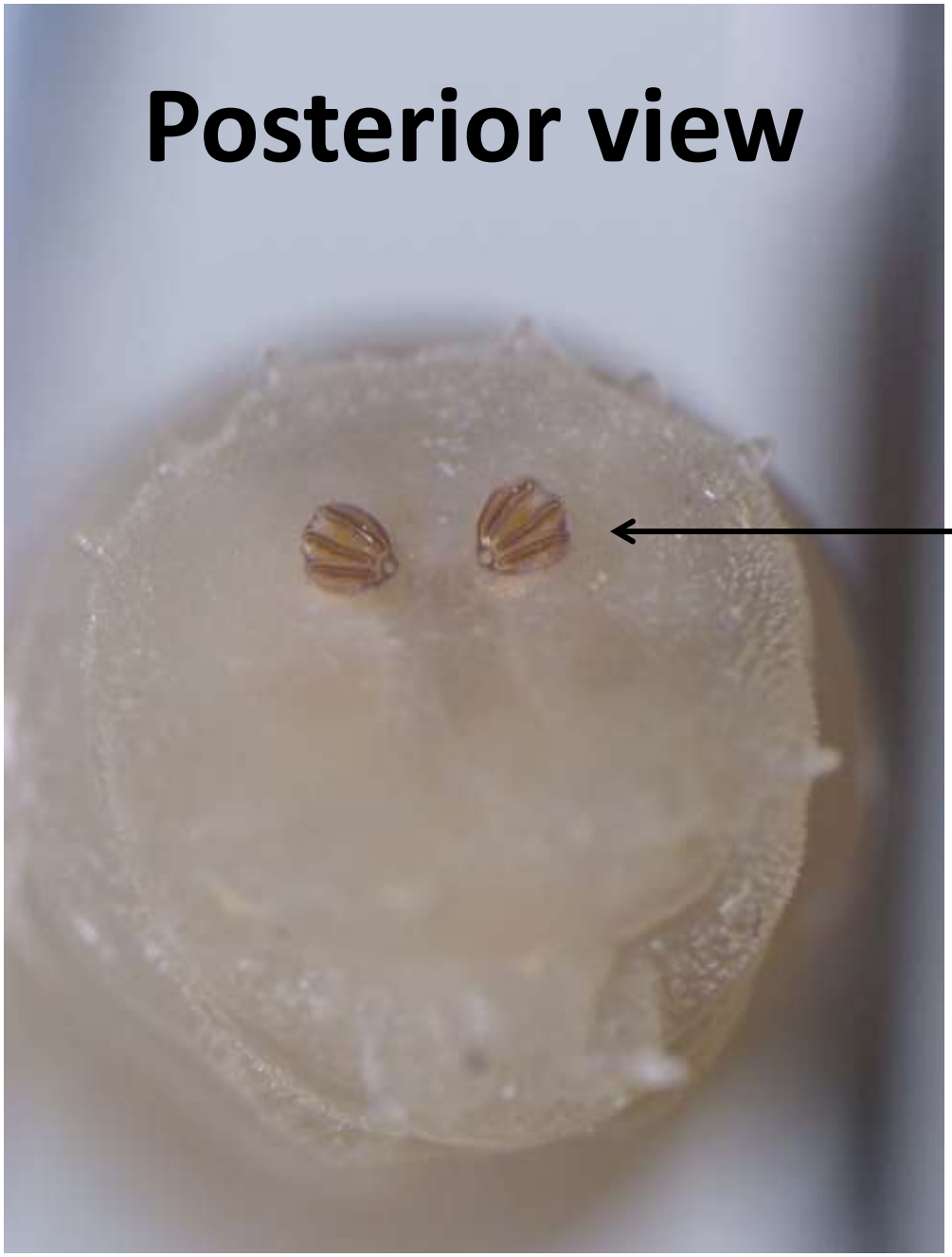
Characteristic of fly larva



Heo CC (2012)


Anterior spiracles
antenna
Mouth hook

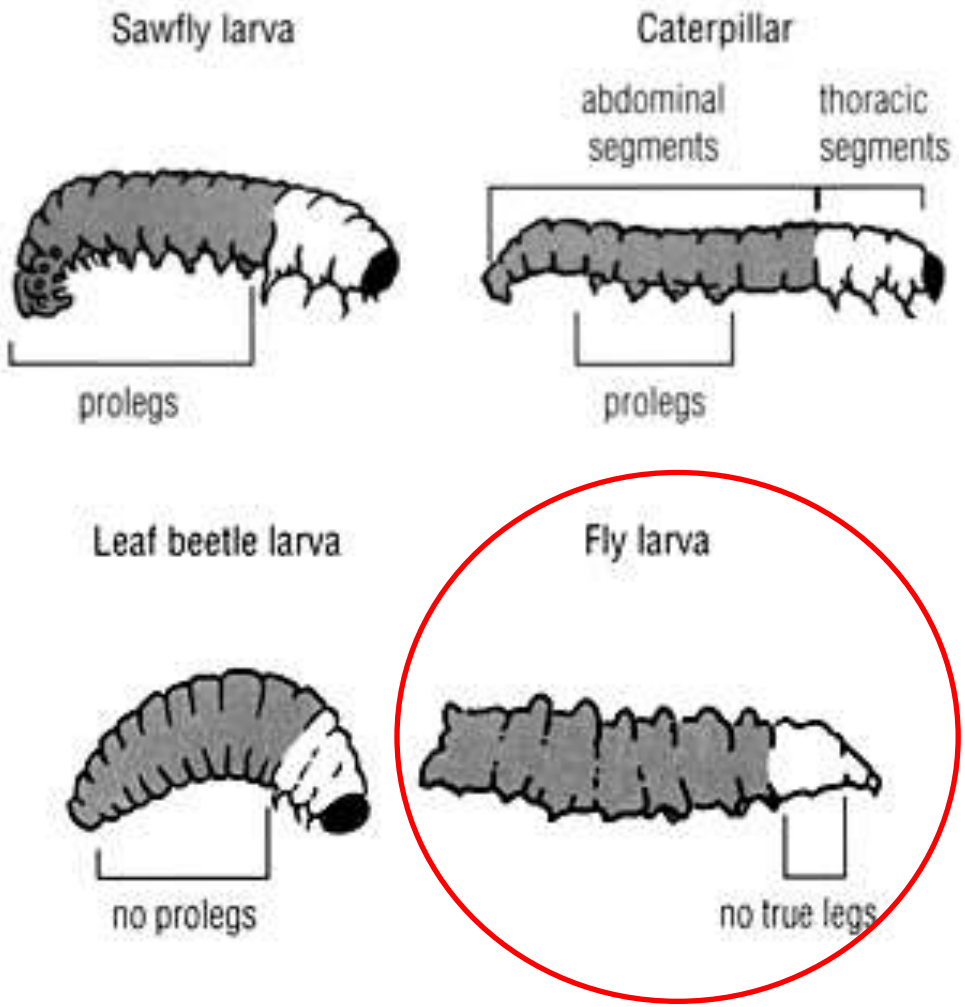
Posterior view



Hairy maggots – *Ch. rufifacies*


Heo CC (2013)

Identification of Insect Larva



Flies that are Beneficial in Medicine:

1. Maggot Debridment Therapy (MDT)

- Maggots are use in therapy to **heal wounds** by removing dead tissues.
- In Malaysia, fly larvae (maggots) of a cupreous blow fly, ***Lucilia cuprina*** (family Calliphoridae) are use in this treatment

Maggot Debridement Therapy (MDT)

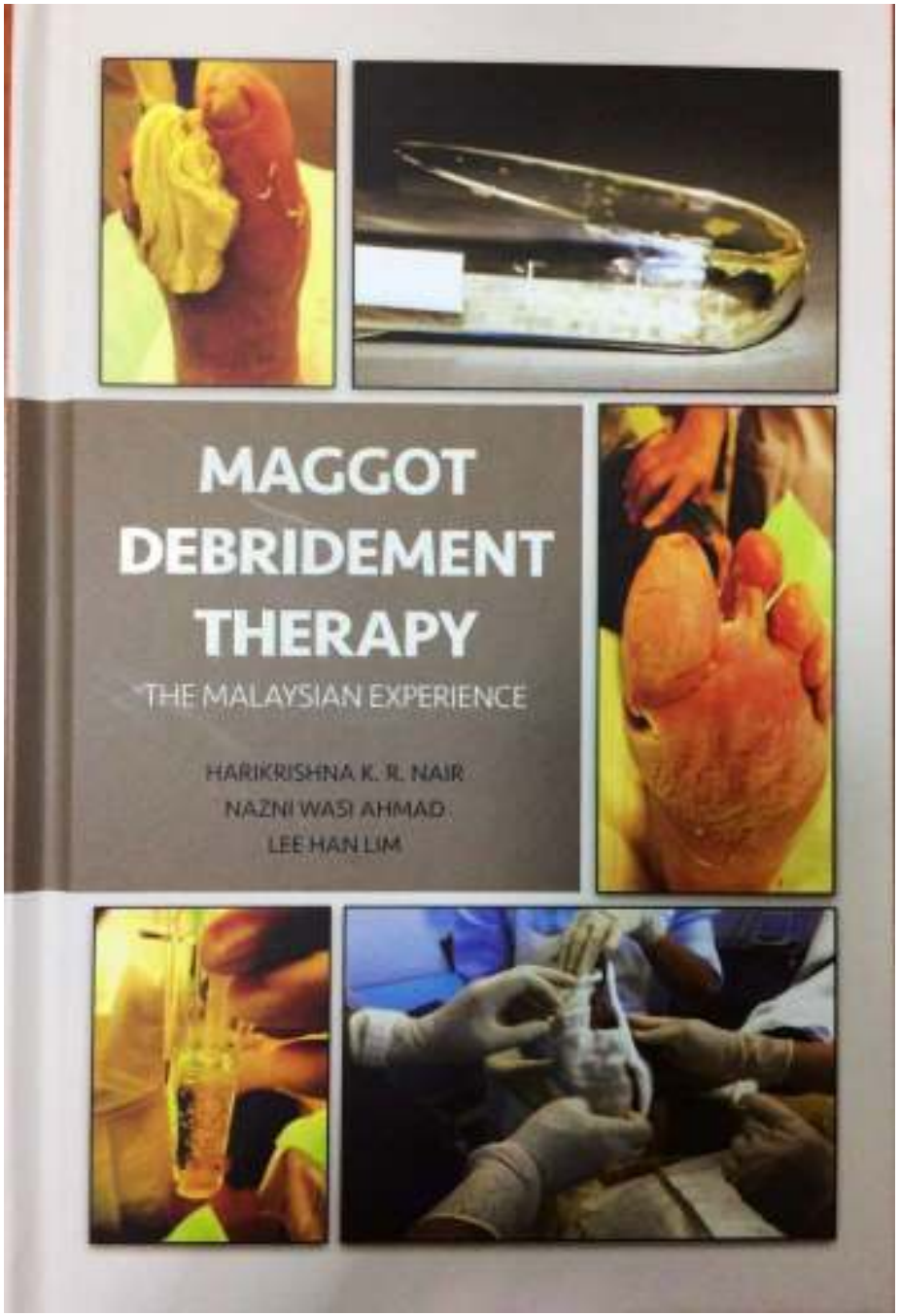
Maggot Debridement Therapy (MDT)

Before treatment

After treatment

Maggot Debridement Therapy (MDT)

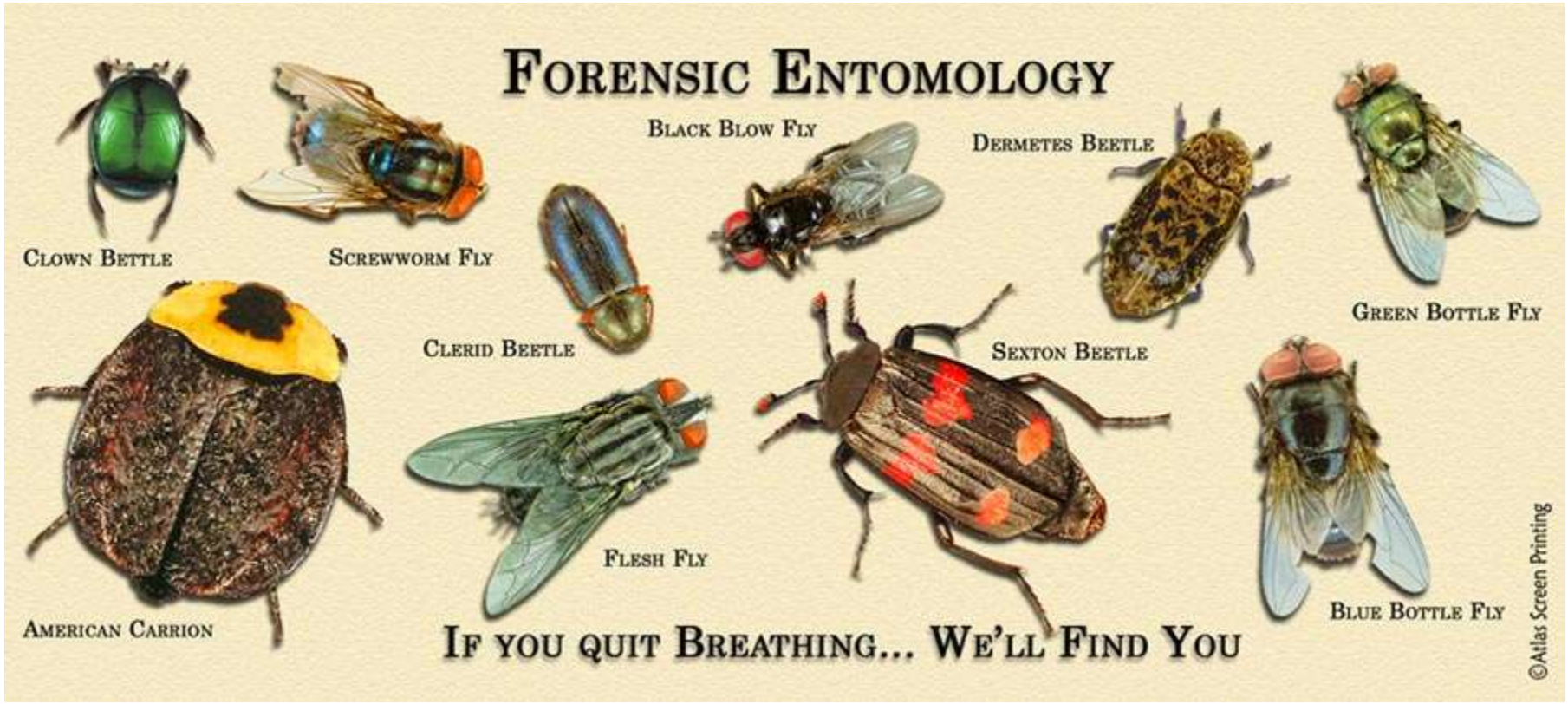
http://www.btmcl.com/eng/cases2.html


MAGGOT
DEBRIDEMENT
THERAPY
THE MALAYSIAN EXPERIENCE
HARIKRISHNA K. R. NAIR
NAZNI WASI AHMAD
LEE HAN LIM

Insects that are Beneficial in Medicine:

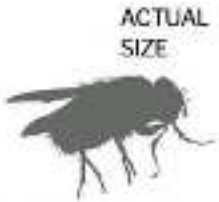
2. Forensic investigation (Forensic entomology)

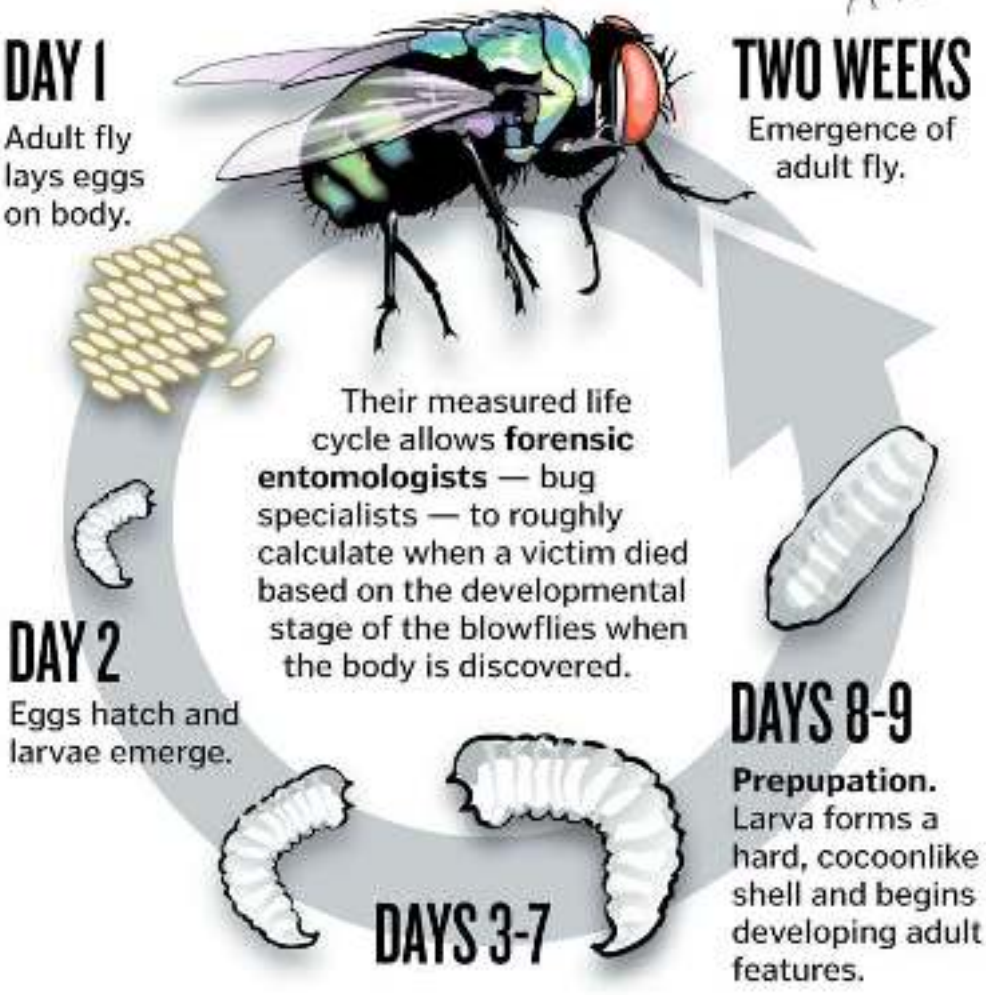
- The use of **insect in legal investigations**:
  - Determination of **time since death** (minimum post-mortem Interval, mPMI)
  - **Causes of death**
  - **Movement of body**
  - **Site of injuries**
  - **Location of death scene**
  - **Negligence and torture**


FORENSIC ENTOMOLOGY
CLOWN BETTLE
SCREWWORM FLY
BLACK BLOW FLY
DERMETES BEETLE
GREEN BOTTLE FLY
CLERID BEETLE
SEXTON BEETLE
AMERICAN CARRION
FLESH FLY
BLUE BOTTLE FLY
IF YOU QUIT BREATHING... WE'LL FIND YOU
©Atlas Screen Printing

The life cycle of a blowfly

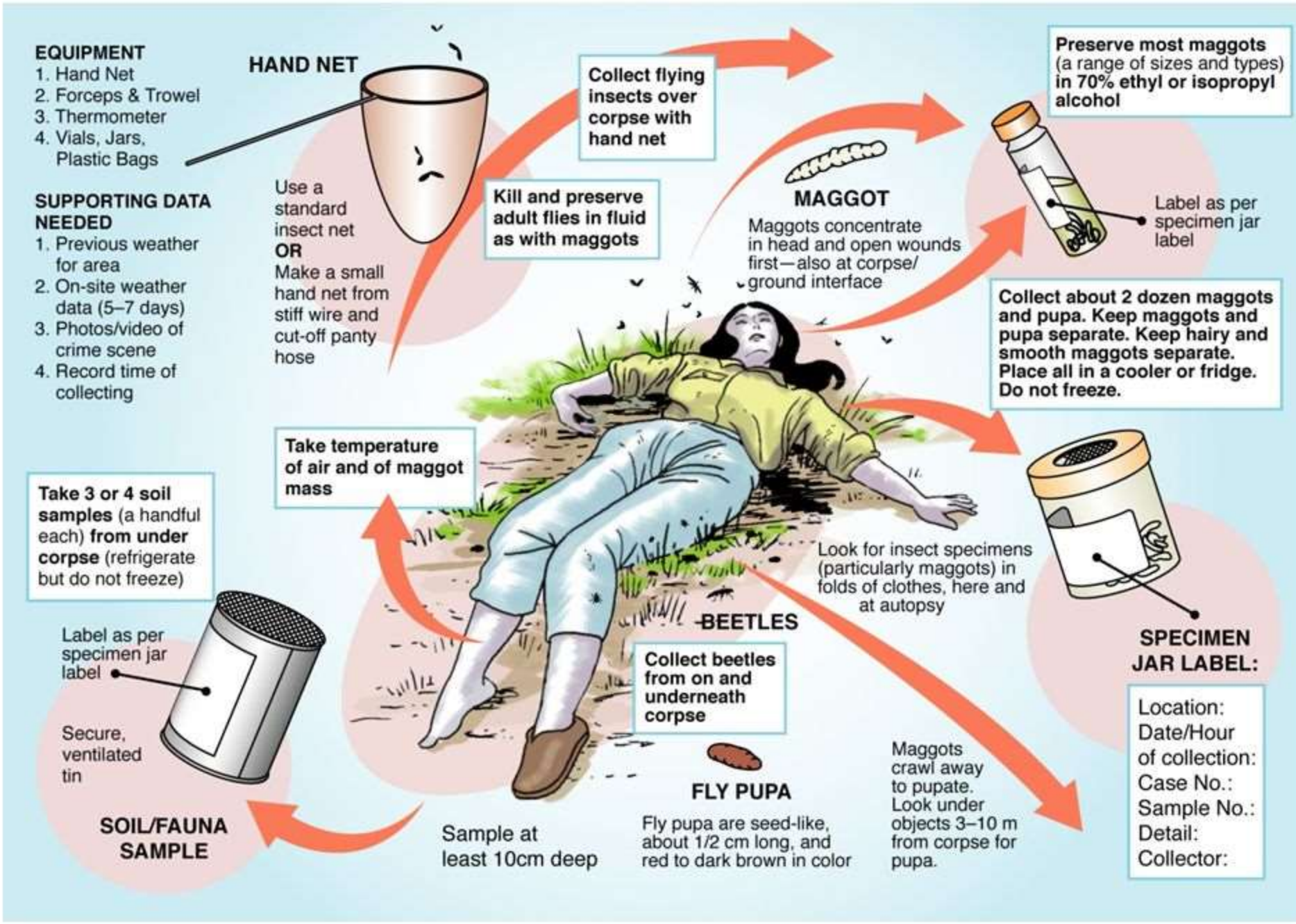
It never takes these insects long to make their way to a decomposing body, and the first thing they do when they get there is lay eggs. This timeline is based on a constant temperature of 70 degrees.





SOURCE: Michigan State University Dept. of Entomology

THE PLAIN DEALER


EQUIPMENT
1. Hand Net
2. Forceps & Trowel
3. Thermometer
4. Vials, Jars, Plastic Bags
SUPPORTING DATA NEEDED
1. Previous weather for area
2. On-site weather data (5–7 days)
3. Photos/video of crime scene
4. Record time of collecting
HAND NET
Use a standard insect net
OR
Make a small hand net from stiff wire and cut-off panty hose
Collect flying insects over corpse with hand net
Kill and preserve adult flies in fluid as with maggots
MAGGOT
Maggots concentrate in head and open wounds first—also at corpse/ground interface
Preserve most maggots (a range of sizes and types) in 70% ethyl or isopropyl alcohol
Label as per specimen jar label
Collect about 2 dozen maggots and pupa. Keep maggots and pupa separate. Keep hairy and smooth maggots separate. Place all in a cooler or fridge. Do not freeze.
Take temperature of air and of maggot mass
Take 3 or 4 soil samples (a handful each) from under corpse (refrigerate but do not freeze)
Look for insect specimens (particularly maggots) in folds of clothes, here and at autopsy
BEETLES
Collect beetles from on and underneath corpse
SPECIMEN JAR LABEL:
Location:
Date/Hour of collection:
Case No.:
Sample No.:
Detail:
Collector:
Label as per specimen jar label
Secure, ventilated tin
SOIL/FAUNA SAMPLE
Sample at least 10cm deep
FLY PUPA
Fly pupa are seed-like, about 1/2 cm long, and red to dark brown in color
Maggots crawl away to pupate. Look under objects 3–10 m from corpse for pupa.

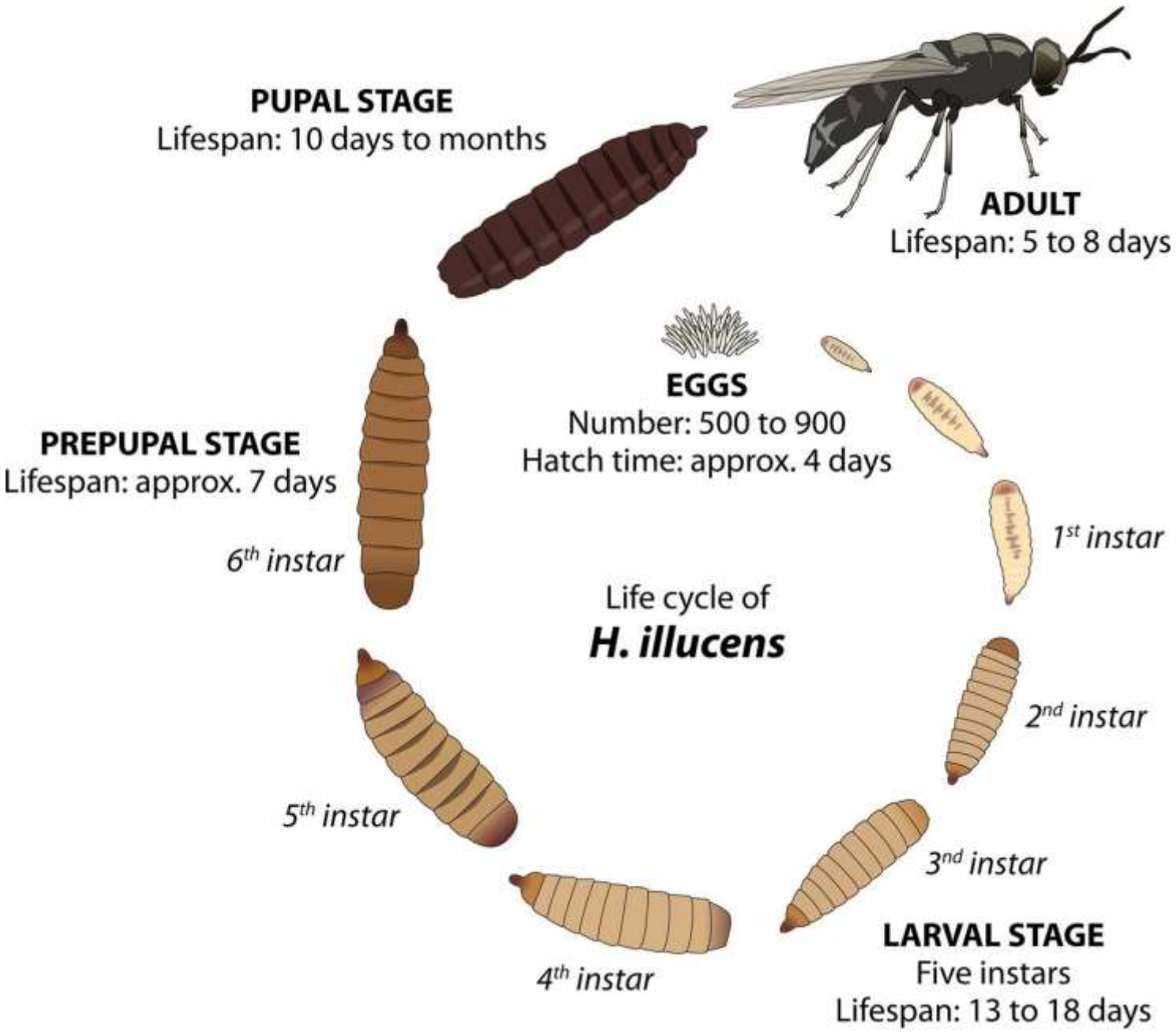
Black Soldier Flies, *Hermetia illucens*

- Black soldier flies, *Hermetia illucens* are an excellent source of **sustainable protein** for aquaculture, animal feed (e.g., poultry), pets and human nutrition

- It is also well known that the larvae are efficient feeders of decomposing organic materials such as household food and agricultural wastes

Black Soldier Flies

Source of Protein


PUPAL STAGE
Lifespan: 10 days to months
ADULT
Lifespan: 5 to 8 days
EGGS
Number: 500 to 900
Hatch time: approx. 4 days
1st instar
2nd instar
3nd instar
LARVAL STAGE
Five instars
Lifespan: 13 to 18 days
4th instar
5th instar
6th instar
PREPUPAL STAGE
Lifespan: approx. 7 days
Life cycle of
H. illucens

Food Waste Recyclers

Entomophagy

- Entomophagy is the **human consumption** of insects and arachnids as **food**

Entomophagy in UiTM

Grasshopper cookies

Grasshopper layered cake

From Sambal belacan to Sambal “belalang-can”

Edible Insects

- Crickets
- Locusts
- Silkworms
- Mealworms
- Cicadas
- Ants
- Grubs

Edible Insects

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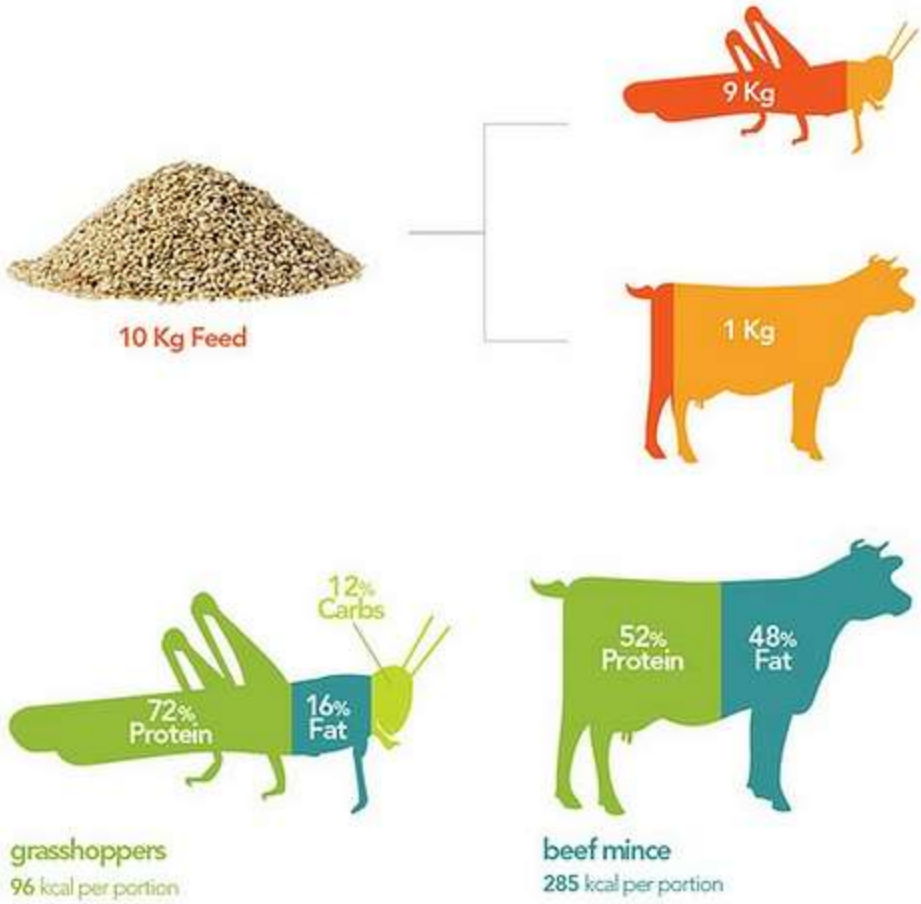
The Benefit of Entomophagy



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13 May 2013

https://www.bbc.com/news/world-22508439

Inspired Life

Would you eat insects to help save the planet? These companies are betting yes.

The Washington Post

Jan 9, 2019

Relationship between Carcasses, Flies, and Public Health

- **Mass mortality events (MMEs)** are increasing worldwide (Fey et al. 2015)

- Saprophagous invertebrate communities **potentially cannot efficiently** process large scale introduction of vertebrate remains into an environment (Tomberlin et al. 2017)
    - Microbe **proliferation and dissemination**
    - **Increase** in environmental contamination
    - Potential **disease outbreak**

Conclusion

- **NOT** all insects (or flies) are **bad**
- We must **appreciate** and **preserve** our mega-biodiversity
- **Healthy ecosystem**
- Healthy **environment**, healthy **animals**, healthy **humans**
- **OneHealth**

Thank You

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