

Forensic Pathology and Entomology

An expert in the field has to

- Establish the **cause of death**
- Establish the **time of death**
- Infer the type of **weapon** used
- Distinguish homicide from suicide
- Establish **identity** of the deceased
- Determine effects of pre-existing conditions



Manner of Death – the way a person can die

- **Natural** death – cessation of body functions due to age or disease
- **Accidental** death – unplanned events
- **Suicidal** death – purposefully kills self
- **Homicidal** death – killed by someone else
- **Undetermined** – evidence is not providing a clear manner

Try these . . .

1. A woman who has an undiagnosed heart condition is attacked while running in the park. She dies of a heart attack that occurs during the physical assault. Is her death accidental or a homicide? Explain.
2. An elderly man is suffering from pneumonia. His daughter neglects him by not providing proper nutrition or health care while he is ill. The man dies while ill. Is his death natural or homicide? Explain.

Cause and Mechanism of Death

- **Cause** of death – the reason someone dies
 - Disease, injury, heart attack (resulting in **natural** or **accidental** manner of death)
 - Bludgeoning, stabbing, shooting, drowning, hanging, strangulation, burning, etc (resulting in **homicidal** death)
 - **Proximate** cause of death – the underlying cause; smoking 2 packs a day then dying of lung cancer . . . Smoking = proximate cause

Cause and Mechanism

- **Mechanism** of death – specific change(s) in the body that brought about end of life
 - Loss of blood (cause = shooting or stabbing; manner – suicide or homicide)
 - Heart stops beating (cause = heart attack; manner – natural)

Apply . . .

- On the autopsy report the medical examiner wrote “massive trauma to the body leading to pulmonary arrest”
 - What is the cause of death?
 - What is the mechanism of death?

Time of Death

- First thing to remember is that all cells in the body **do not** die at the **same time**. It will take a period of hours for every cell to finally die
 - Chicken running with head cut off
 - Dead individual sitting up

Changes after death

- Heart stops beating so blood will **no longer circulate** and the cells in the body will not get fresh oxygen or remove carbon dioxide
- Brain, muscles, nerves stop working as their levels of **oxygen** drop
- As cells die they break down (**autolysis**); cell membrane weakens . . . Enzymes digest cell contents

Changes after death

- The normal controls on **bacterial growth** have been removed so the bacteria grow uncontrollably resulting in many of the changes seen in decomposition
- Temperature will affect the rate at which the changes occur – **warmer** temp = faster decomposition/changes; lower temp = slower

Algor mortis

- = "death heat"
- Body cools until = environment temp
- **0.7-1.4°F** drop per hour (1.4°F in the first 12 hours, 0.7°F after 12 hours); **0.39-0.78°C**
- $(98.6^{\circ}\text{F} - \text{liver temp}) / 1.4 = \text{hours since death}$
- $(37^{\circ}\text{C} - \text{liver temp}) / 0.78 = \text{hours since death}$
- $\text{Temp loss} = (0.78^{\circ}\text{C/hr}) \times \text{hours dead}$

Variables that affect temp drop

- Hotter environmental temp
- Windy
- Excess body fat
- Clothed
- lose heat more **slowly**
- lose heat more **quickly**
- lose heat more **slowly**
- Lose heat more **slowly**

Livor Mortis

- = “death color”
- Blood begins to **settle** as soon as the heart stops and the blood cells, blood vessels and tissues breakdown
- Pooling of blood = **lividity**
- Hemoglobin turns purple . . .
 - Discoloration starts 15-20 min after death
 - Obvious 1-2 hrs after death; disappear when pressed
 - Fixed 4-6 hrs after death

Livor mortis

- Can be affected by constrictive clothing, etc.
- Not only gives time of death but can also indicate the **position** of the body



Rigor mortis

- = “death stiffness”
- Due to loss of **oxygen** in muscles – build up of lactic acid and calcium
- Starts in facial muscles
- Begins **2 – 4** hours after death
- Average body complete rigor within **24** hrs
- Stiffness lasts 36 – 48 hrs; disappears from small muscles first

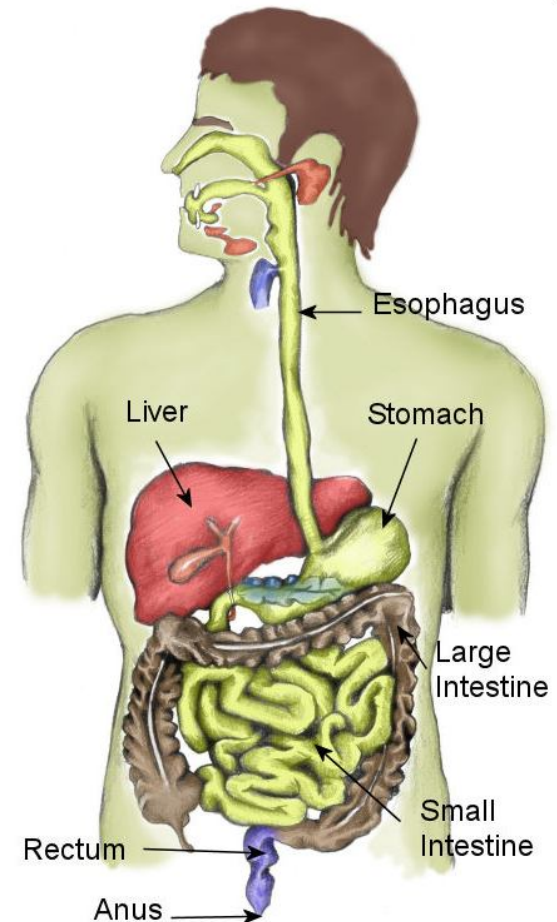
Factors affecting the onset of rigor

- Temperature
- Body weight
- Type of clothing
- Illness
- Physical activity before death
- Sun exposure
- Warmer temp will **accelerate** onset
- Fat stores oxygen and **slows** rigor
- If body is warmer, rigor is **faster**
- Body temp higher due to fever, rigor is **faster**
- More active = higher body temp = **faster** rigor
- In the sun = higher body temp = **faster** rigor

- Because so many things can affect the rate of stiffening, rigor alone **cannot** accurately determine time of death

Gastrointestinal changes

- Rate of normal digestion
 - **4 – 6** hours to move food from stomach to small intestine
 - **12** hours to move through small intestine
 - **24** hours from food being ingested to have it exit large intestine



Changes in eye

- Thin film on eye after 2-3 hours if eyes were open; 24 hours if eye is closed
- Potassium builds up in fluid of eye

Stages of Decomposition

1. Early postmortem decay
 - Within **2** days
 - Internal **microorganism** activity
 - Insect activity
 - Production of internal gases (**autolysis**)
 - **Lividity** begins
 - Face is discolored



Stages of decomposition

2. Putrefaction

- After **4** days
- Increased microorganism and insect activity
- **Bloating** from gas build up
- Odor is present



Stages of decomposition

3. Black putrefaction

- **6 – 10** days
- Blackened flesh
- Strong **odor**
- **Collapse** of the body cavities
- Fluids leak as tissues liquify
- Skins sloughs off

Stages of decomposition

4. Butyric fermentation
5. Dry decay
6. Skeletonization



Forensic Entomology

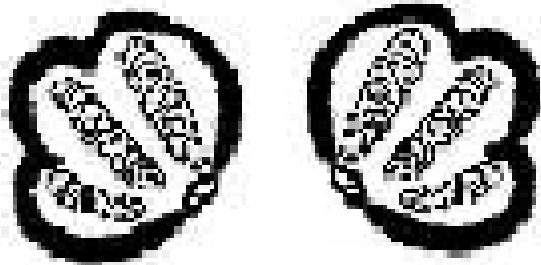
- Insects arrive at body within **minutes** of death if the body is exposed
- Insects are attracted to the **warmth** and **smell** of the body
- Females lay their eggs in the **openings** of the flesh – the body provides a constant supply of **nourishment**



Bugs

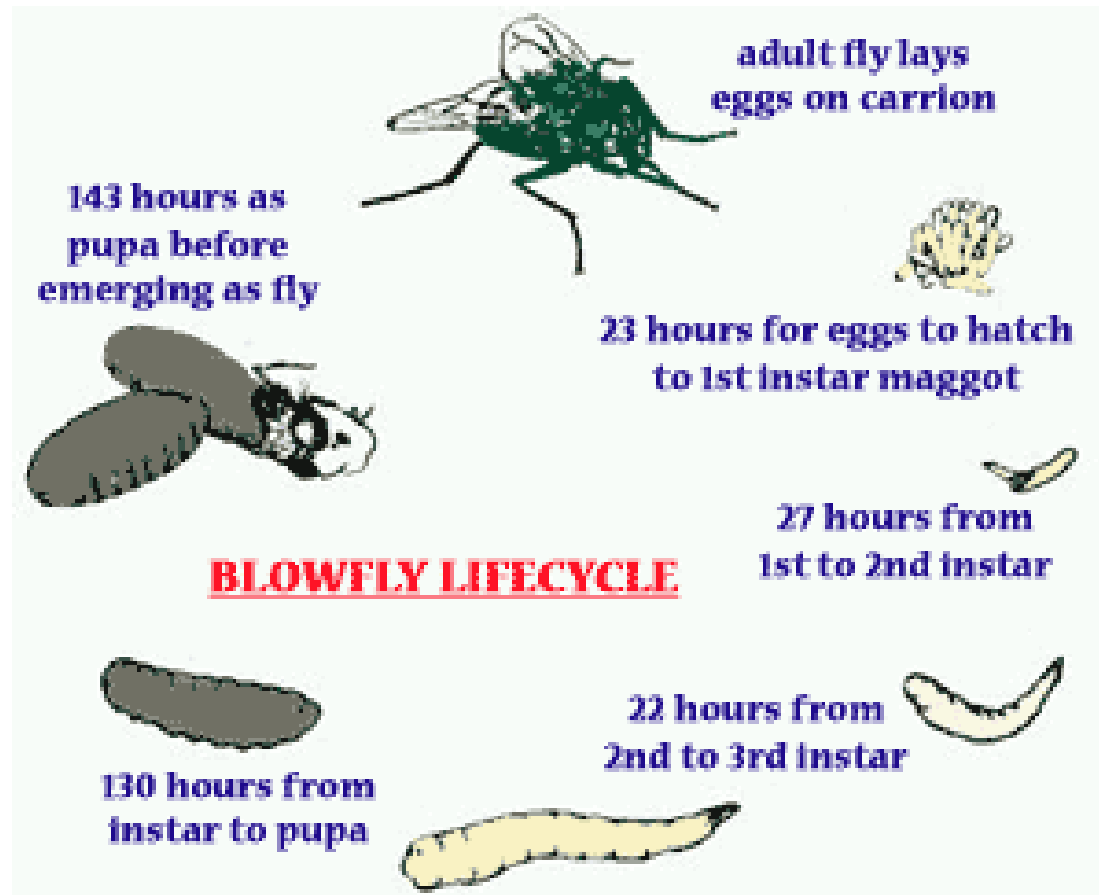
- Insects arrives in predictable order
 - Blowflies (often the first)
 - Wasps (lay eggs on other larvae)
 - Cheese skippers (attracted to fluid seepage)
 - Mites and beetles (prefer dry conditions)

identification of larvae



- looking at the posterior end you will find spiracles
- these are the breathing openings
- look for position of them and the dark border around them

Insect life cycle



Insects for reason other than time of death

- Determining if the body has been **moved** . . .
No insects is a problem too!
- Insects or parts of insects can link **suspect** to the victim/crime . . . Insect bites too
- Determining **cause** of death – poisoning . . .
Examine the maggots and/or **pupal cases** for evidence of drugs
- In the future – extract blood (DNA) from blood sucking insects



Cool jobs – forensic entomologist

- <http://link.brightcove.com/services/player/bcpid1753162255?bctid=1719751763>

Using bones

- “**green**” bone = greasy to the touch, fairly recent find
- **Bleached** bone = out in the sun
- Stained and dark bone = **buried**
- Lacy cracking on surface = has been exposed to **freezing** temperatures
- Candle wax smell of a long bone – due to residue from **bone marrow**; may linger for up to **50** years

Chemistry of death

- As the body decays, some compounds are broken down and others are created – the changes are **predictable**
- Some of these changes can be measured in the body organs
- Some of these changes can be measured in the **soil** around the body or where a body might have been
- Analysis is done with **gas chromatography**

Autopsy site

1. **External** exam – look at the body, clothing and anything else that was brought in with it; this is done to look for **trace evidence**
 - Fingerprints are lifted
 - Rape kit if rape is suspected
 - Swab for gunshot residue if suicide is suspected
 - Collect **hair** and **fibers** from body and clothing
 - Clean under the **fingernails**

Autopsy

2. Document

- a. Photograph the body clothed and unclothed
- b. X-ray
- c. Weigh and measure

3. Clean the body

Autopsy

4. Position body on back then make the first incision – **Y-incision**
 - a. this goes from shoulder to sternum then down midline
 - b. Rib cage is remove
 - c. Thoracic and abdominal cavities are examined
 - d. Scalp is pulled off . . . brain is examined

Dr G.

- [http://www.howstuffworks.com/autopsy.htm/
printable](http://www.howstuffworks.com/autopsy.htm/printable)

Injuries that cause death

1. **Asphyxia** – insufficient oxygen reaching the organs
 - a. Strangulation – enlarged heart, enlarged veins, **cyanosis** (blue lips and fingertips)
 - b. Drowning – foam “cone” covering mouth/nostrils, enlarged larynx with no fluids in lungs/stomach (“**dry drowning**”)
 - c. Smothering – small contusions/lacerations on **inner lips**, cyanosis, **petechial** hemorrhage

2. Bullet wounds – greater the energy, greater the tissue destruction; **velocity** is more important than **size/caliber**
 - a. entry wound – usually smaller than exit
 - b. Exit wound
 - c. Powder burns

3. Stab wounds

- a. **Slash** wounds – graze surface
- b. **Hesitation** marks – rectangular
- c. **Incision** wounds – longer than deep
- d. **Puncture** wounds – clean cut edges
- e. Pre or post-mortem
 - i. Pre-mortem **gapes and bleeds**
 - ii. Post-mortem does not gape or bleed much

4. Blunt force
5. Rape wounds
6. **Poisoning** – discoloration, unusual odors, injection marks
7. Burn wounds – **contraction** of muscle proteins
8. Traffic fatalities