# Welcome To Unit 4

# Unit 4 Criminal Justice Forensic Science

- **Unit Dates 23 August – 8 September**
- **4.1 Explain the process of performing an autopsy.**
- **4.2 Research PMI (Post Mortem Interval).**
- **4.3 Compare the five manners of death.**
- **4.4 Distinguish the causes of death commonly associated with homicide.**

# Death: Meaning, Manner, Mechanism, Cause, and Time

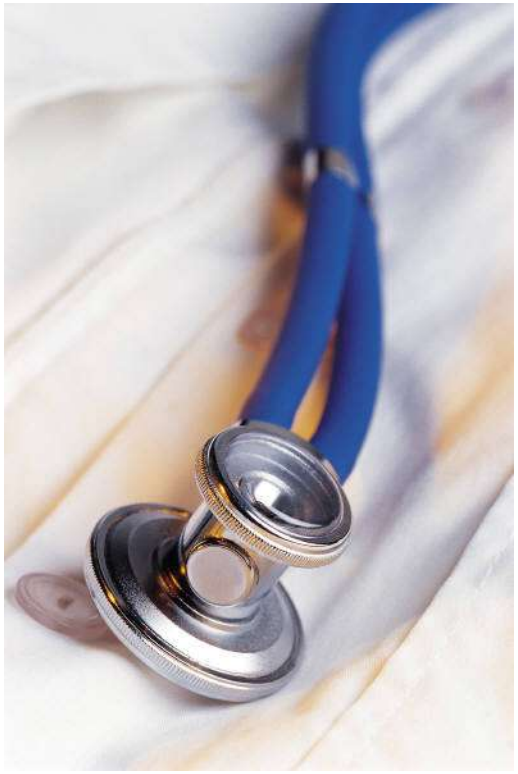
**Our Day Begins When Your Day Ends**

# Opening Activity

- How do you know someone is dead or alive?
- Make a two column chart and label it "Death or Alive" and write as many characteristics as you can.

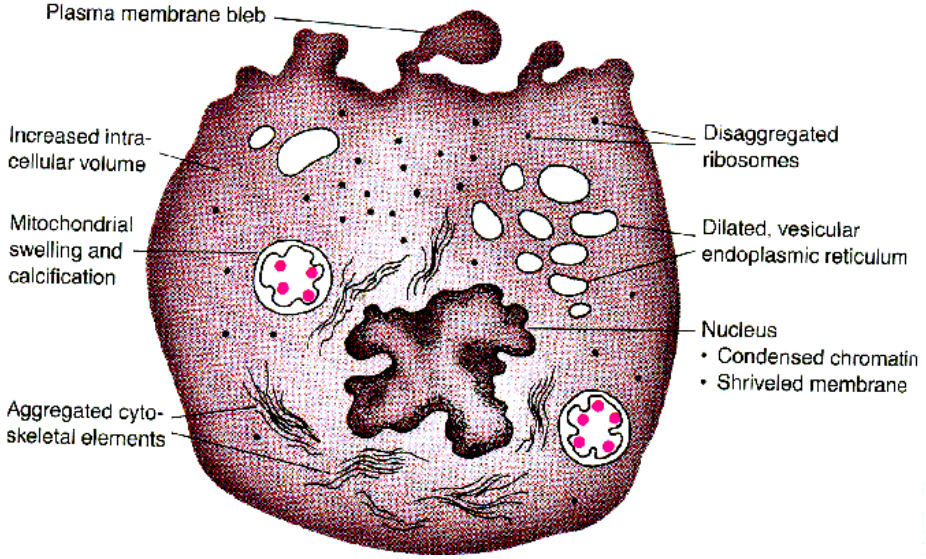
| Dead | Alive |
| --- | --- |
| | |

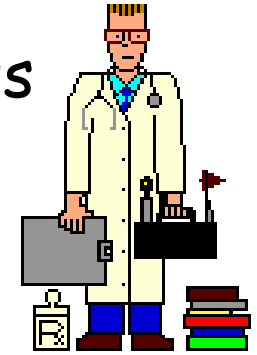
# Introduction



Stethoscope

- ✓ Death is the cessation or end of life.
- ✓ Death is the irreversible cessation of circulation of blood and brain activity.
- ✓ Autolysis occurs when cells break dow





- **Forensic medicine** is the application of various medical specialties to legal issues.
- **Pathology** refers to the study of disease.
- **Forensic Pathologist** is a medical doctor who studies injuries and disease to determine the **cause** and **manner** of death. (in suspicious deaths)


- **Medical Examiner** **is** a forensic pathologist who conducts autopsies to determine the **cause, manner**, and **mode** of death by examining the internal organs of the corpse.
- **Coroner** is a public officer whose primary function is to investigate by inquest any death thought to be of other than natural causes.

# Is a coroner the same as a medical examiner?

- Each state has a law requiring that either a coroner or a medical examiner oversee the investigation of unexpected deaths.

- Georgia Counties usually have a coroner that is elected, but they don't necessarily perform medical examinations concerning deaths or perform autopsies.

# Where is our Medical Examiner?

Henty County has a Coroner, however Georgia Bureau of Investigation's Crime Lab Performs most of the autopsies for suspicious deaths in this area.

The County Coroner position for Henry County is up for election this year!

# The Manner of Death

- There are 4 ways a person could die, referred to as the manner of death:
  1. Natural
  2. Accidental
  3. Suicide
  4. Homicide

- A fifth manner of death should be added:
  5. Undetermined or Unknown

# Cause and Mechanism of Death

- The reason someone dies is called the **cause of death**.
- Proximate cause of death refers to an underlying cause of death as opposed to the final cause.
  - Example: radiation→cancer= radiation exposure
- Mechanism of death describe the specific change in the body that brought about the cessation of life.

**Examples:**

**Manner of death**: - homicide

**Cause of death:** - smothering

**Mechanism of death**: - asphyxia

**Manner of death**: - homicide

**Cause of death:** - stabbing

**Mechanism of death:** - loss of blood (exsanguination)

- Man shot during robbery. Man stabilizes. Develops pneumonia. Followed by kidney failure, liver failure, heart failure, death. Had prior lung and heart disease, and probably would have survived if not for these diseases.

**Manner of death**: - homicide

**Cause of death:** - gunshot

**Mechanism of death:** - heart failure

# Review Causes and Mechanisms of Death

## TAKE NOTES

- **Examples of causes of death:**
  - heart attack, gunshot wound, skull fracture, diseases or injuries, stroke, burning, drowning, strangulation, hanging, suffocation, massive trauma, bludgeoning
- **Examples of mechanisms of death:**
  - Exsanguination (bleeding to death)
  - Sepsis (infection in blood stream)
  - Brain trauma (cerebral contusion)
  - Brain bleeding (intra-cerebral bleed)
  - Stop breathing (asphyxia)
  - Pulmonary arrest
  - Cardiac arrest

# Whitney Houston death certificate:

# No cause of death listed


Tarrant County Death Records

The manner, cause and mechanism of death of:

http://jbrwdi.forumotion.com/

- **Jon Bennet Ramsey**
  - Manner – homicide
  - Cause – strangulation
  - Mechanism – asphyxiation - respiratory arrest

Michael Caulfield/WireImage.com

- **Whitney Houston**
  - Manner – accidental
  - Cause – drowning, effects of heart disease and cocaine use
  - Mechanism – Pulmonary arrest

- **Michael Jackson**
  - Manner – homicide
  - Cause – acute propofol intoxication
  - Mechanism – cardiac arrest

- **Robin Williams**
  - Manner – suicide
  - Cause – hanging
  - Mechanism – asphixiation

Lester Cohen/WireImage.com

# Time Of Death

- During an autopsy, a FE wants to determine when the person died.
- Many factors are used to approximate the time of death.
  - Livor Mortis
  - Rigor Mortis
  - Algor Mortis
  - Stomach and intestinal contents
  - Insects

# Livor Mortis

- Death color
- Blood seeps down to the tissues and settles into the lower parts of the body.
- Hemoglobin turns purple when it spills out of cells.
- Purplish color is visible wherever blood pools.
- Pooling of blood (lividity), provides a clue as to how long the person has been dead.
- It begins about 2 hours after death and becomes permanent after 8 hours.
- If corpse is left outside on a hot summer day, livor mortis takes place at a faster rate. Cool room, livor mortis is slower.
- It's also affected by anything impeding flow of blood, such as belts, wristwatches, etc.
- It also provides the position of corpse during 1st 8 hrs.
- It reveals if a body has been moved.

**Livor Mortis** also known as **hypostasis** or **Lividity**

(Latin: *livor*—"bluish color," *mortis*—"of death")

**postmortem lividity** (Latin: *postmortem*—"after death", *lividity*—"black and blue")

Lower legs showing both lividity and blanching.

Pressure points from ground, belts, etc. prevent blood from settling

Body does have lividity, but shows blanching under pressure.

# Questions:

1. What's another name for Livor Mortis?
2. Livor mortis can provide important clues. What are they?

3. What factors could affect livor mortis?

4. How a criminal might be able to disguise the time of death by controlling the ambient conditions that affect livor mortis.

# Questions and Answers

1. What's another name for Livor Mortis?

   Lividity, hypostasis

2. Livor mortis can provide important clues. What are they?

Time of death, position of corpse, if the body has been moved

3. What factors could affect livor mortis?

   Ambient Temperature (warm=faster) (cold room=slower)

   Anything impeding flow of blood (tight belt or wristwatch)

4. How a criminal might be able to disguise the time of death by controlling the ambient conditions that affect livor mortis.

   Accept logical answers –Freezer, Trunk of car

# Rigor Mortis

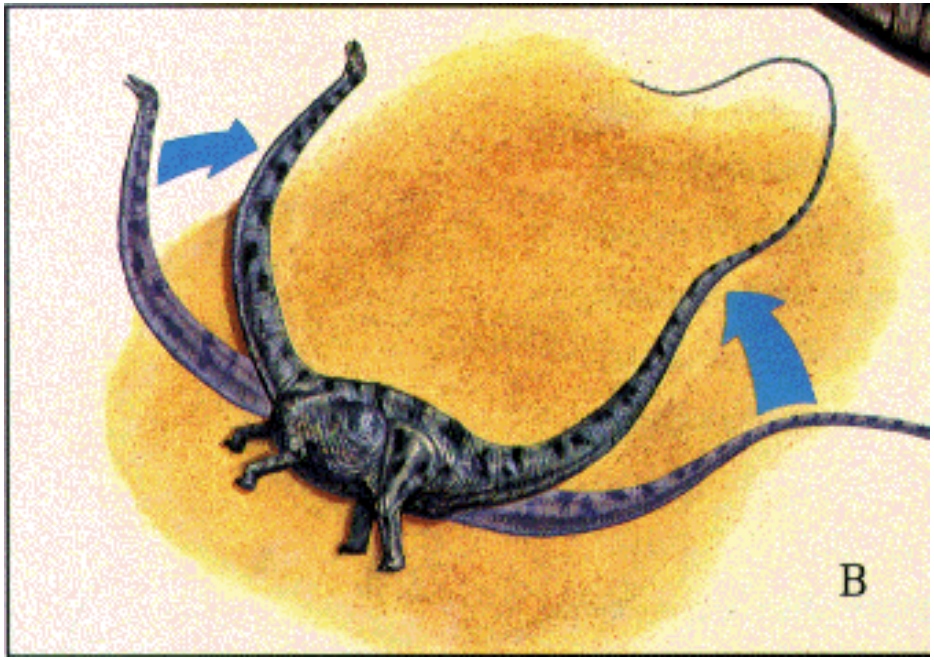
- Death stiffness
- It is temporary.
- Used to determine the time of death.
- Starts within 2 hours after death.
- Stiffness starts in the head (eyelids) and gradually works its way down the legs.
- The body is at the most rigid state after 12 hours.
- Stiffness disappears after 36 hours.
- It may remain up to 48 hours depending on body weight and ambient temperature.
- Stiffness occurs because skeletal muscles are unable to relax and remain contracted.

- ***Rigor Mortis*** – refers to a stiffening of the body resulting from lack of oxygen pumped to the muscle cells after the heart stops beating.
  - ATP stops being produced
  - It begins in the eyelids and lower jaw
  - It spreads to the neck and rest of body
  - Completely set in within 12 hours of death
  - Lasts appx 30 to 36 hrs
  - Body goes back to a non-rigid state
  - Loosening of rigid muscles follows the same progression as when it sets in. (eyes, jaw, neck, body)

# Rigor Mortis

- Many factors affect when rigor mortis sets in and how long it last.
  1. Ambient temperature
     - The cooler the body, the slower the onset of rigor.
     - The warmer the body, the faster the onset of rigor.
  2. Person's weight – body fat stores extra oxygen and will slow down rigor. Obese – slows rigor Thin – Accelerates rigor
  3. Type of clothing – presence of clothes accelerates rigor. Naked body slows down rigor.
  4. Illness – with fever, rigor will set in faster. Hypothermia , the onset of rigor will be slower.
  5. Physical activity - exercising, faster
  6. Sun exposure – direct sunlight, faster

An unfortunate victim of suicide. Note that rigor mortis has maintained the position of his arms after the shotgun has been removed.




Contraction of muscles as rigor sets in.

If a body needs to be transported when rigor mortis is at its peak, it might be necessary to break bones to change the position of the body.

Rigor Mortis case

# Questions:

1. List and explain the 6 factors that affect rigor mortis.

2. Refer to Figures 11-8 and 11-9 and propose a set of conditions that would cause rigor mortis to proceed the quickest and the slowest and explain why.

4. Complete Activity 11-1 Calculating Time of Death using Rigor Mortis.

# Algor Mortis

- Algor means chill, Mortis means death.
- It describes the temperature loss in a corpse.
- To take a corpse's temperature, investigators insert a thermometer into the liver.
- Approximately one hour after death, the body cools at a rate of 0.78°C (1.4°F) per hour.
- After the first 12 hours, the body loses about 0.39°C (0.7°F) per hour until the body reaches the same temperature of the surroundings.
- TOD determined by body temperature calculations is always expressed as a range of time because it cannot be calculated exactly.
- Rule of thumb: Heat Loss = 1 degree F per hour.

***Algor Mortis*** - refers to the change of temperature that occurs after death due to the lack of energy.

- 98.6 degrees F **(37 degrees C)** - normal body temperature
- Warm to the touch up to 3 hours after death
- Around 4 to 6 hrs – cool to the touch
- After 24 hrs – temp of the external environment.

# Factors affecting Algor Mortis

- Complete the following chart:

| Factors affecting Algor mortis | Event | Effect | Circumstances |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Factors affecting Algor Mortis

- Complete the following chart:

| Factors affecting Algor mortis | Event | Effect | Circumstances |
|---|---|---|---|
| Temperature | Cold temperature | Accelerate algor | Lose heat faster |
| | Warm temperature | Slows algor | Lose heat slower |
| Wind | Windy | Accelerate algor | Faster heat loss |
| | Calm | Slows algor | Slower heat loss |
| Body fat | Obese | Slows algor | Slow down heat loss |
| | Thin | Accelerate algor | Speed up heat loss |
| Clothing | Presence of clothing | Slows algor | Slow down heat loss |
| | Absence of clothing Naked | Accelerate algor | Speed up heat loss |

# Practice: Examples

First 12 hours: the body looses of (0.78°C) = (1.4°F) per hour.
After the first 12 hours, the body loses about (0.39°C) = (0.7°F) per hour
Normal body temperature = (37°C) = (98.6°F)

1. What is the temperature loss for someone who has been dead for 12 hours?

$$0.78 \times 12 = 9.36°C$$

2. Calculate the time of death if a person has been dead for less that 12 hours. Temperature of dead body is 32.2°C (liver)

$$37° - 32.2°C = 4.8°C$$

How long did it take to lose 4.8°C? 0.78 x unknown # hrs = degrees lost

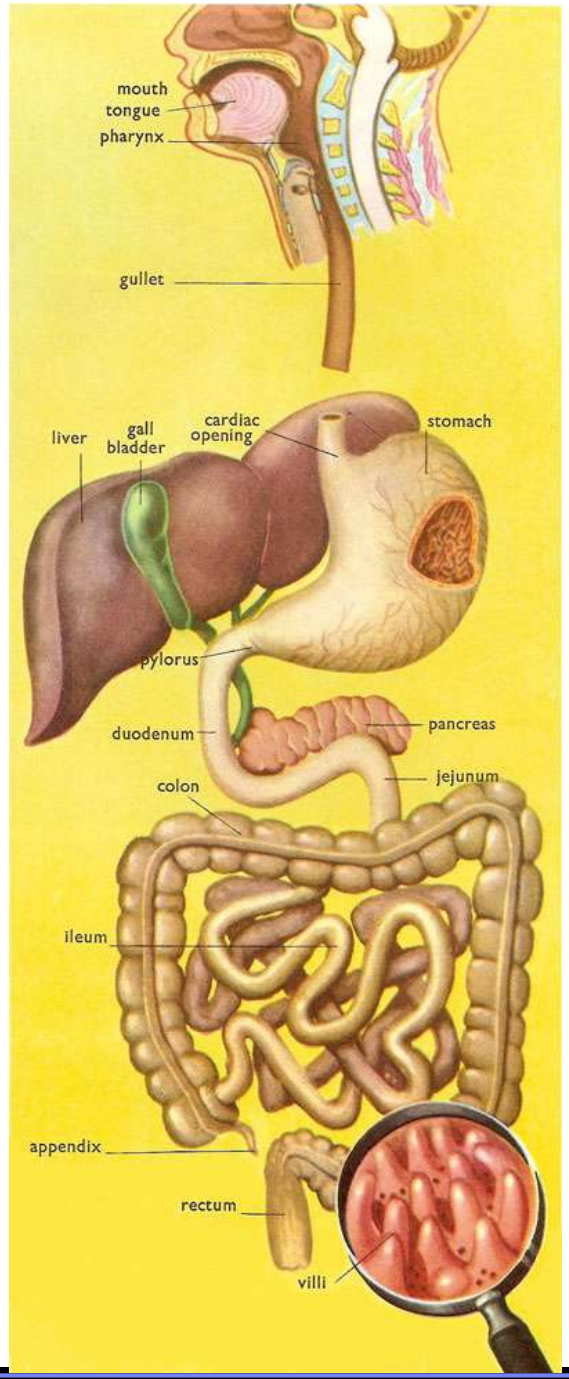
$$0.78 \times X = 4.8°C$$

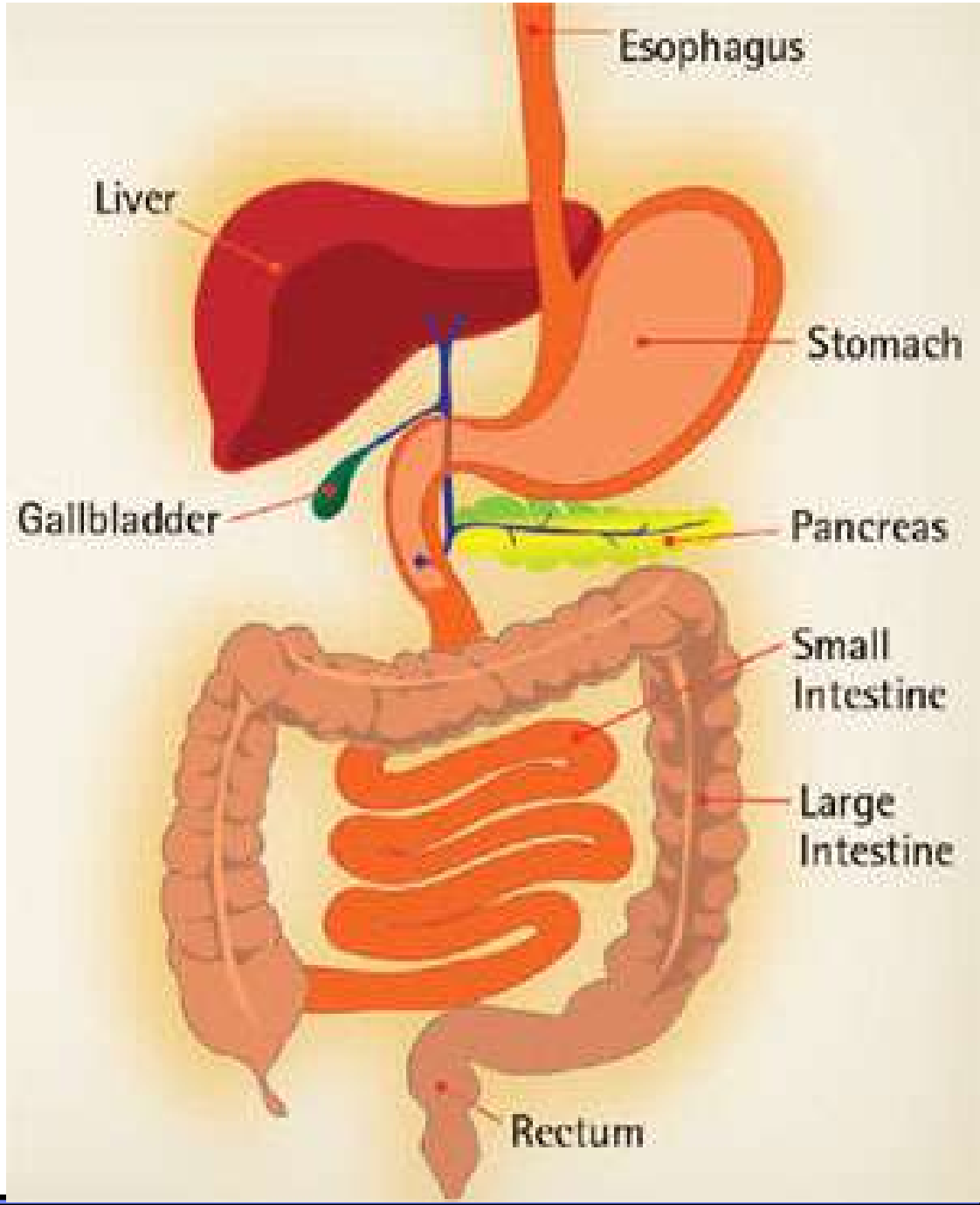
Therefore: $X = \frac{4.8}{0.78} = 6.1$ hours

Refer to Activity 11-2 for more examples and questions.

# Stomach and Intestinal Contents

- It takes 4 to 6 hours for stomach to empty its contents into the small intestine and another 12 hours for the food to leave the small intestine.
- It takes approximately 24 hours from when a meal was eaten until all undigested food is released from the large intestine.
- **Conclusion:**
  - 1. If undigested stomach contents are present, then death occurred 0 to 2 hrs after last meal.
  - 2. If stomach is empty but food is found in the small intestine, then death occurred at least 4 to 6 hrs after a meal.
  - 3. If the small intestine is empty and wastes are found in the large intestine, the death occurred 12 or more hours after a meal.


mouth
tongue
pharynx
gullet
liver
gall bladder
cardiac opening
stomach
pylorus
duodenum
pancreas
jejunum
colon
ileum
appendix
rectum
villi


Esophagus
Liver
Stomach
Gallbladder
Pancreas
Small Intestine
Large Intestine
Rectum

# Changes of the Eye Following Death

- Surface of eye dries out.
- Thin film observed within 2 to 3 hrs if eyes were open and within 24 hrs if eyes were covered after death.
- Following death, potassium accumulates inside vitreous humor.
- The buildup of potassium may be used to estimate the time of death.

# Truth Lies In The Eyes

The eyes of a victim can also hold answers to the time of death, as a thin cloudy film is developed over the eye within 3 hours after death has occurred. The eyeballs become softer as a result of less fluid pressure behind the eye and the degree to which this has occurred can be used as a measure of the time since death. Again, a less common procedure for deaths that evidently occurred out of the limit of several days.

- Take a close look at these eyes.
- Do you see the tiny red dots on the eye's upper white part and the inside of the eyelid? This condition is called petechial (tiny dots) hemorrahage (bleeding). What does this tell a medical examiner? When, during an autopsy, does a medical examiner find such a condition?

# Petechial Hemorrhages

Bleeding is a loss of blood from the body

and hemorrhage means bleeding profusely.


Read and discuss hand-out.
(Time Since Death)

# Estimating Time of Death

## External condition

- ✓ Insects
- ✓ Plants
- ✓ Maggots
- ✓ Animals
- ✓ Environment

## Body Condition

- ✓ Color
- ✓ Temperature
- ✓ Eyes
- ✓ Rigor Mortis
- ✓ Livor Mortis

## Body Internal Condition

- ✓Gastrointestinal Content
- ✓Degree of Putrefaction
- ✓Vitreous fluids electrolyte
- ✓Biochemical changes
- ✓Decomposition

# Questions:

## Use "Time Since Death" worksheet

**List** and **explain** the 6 clues that could be used to estimate the time since death. (from body)

**List** and **explain** 3 clues that could be used to estimate the time since death. (external conditions)

Note:

Please refer to the "Time Since Death" handout given and discussed in class.

# Stages of Decomposition

- A corpse decomposes in predictable ways.
  - Within 2 days after death:
    - Cell autolysis begins
    - Green and purplish color occurs
    - Skin takes marble appearance
    - Face becomes discolor
  - After 4 days:
    - Skin blisters
    - Abdomen swells
  - Within 6 to 10 days:
    - Corpse bloats
    - Chest and abdomen burst and collapse
    - Fluids leak
    - Eyeballs and other tissues liquefy
    - Skin sloughs off

Decomposition = Rotting

# The speed of decomposition depends on:

- Person's age
- Size of body
- Nature of death
  - sick vs healthy individuals
  - Young vs elderly individuals
  - Overweight vs normal weight
- Environment
  - Naked vs clothed bodies
  - Temperature range
    - Decompose faster in 21-37°C
    - Higher temperatures dry out corpses preserving them
    - Lower temperatures prevent bacterial growth and slow down decomposition
  - Humidity
    - Moist environments speed up decomposition
    - Bodies decompose faster in air and slower in water or if buried.

# Factors that could either accelerate or slow down the decomposition process:

| Accelerate | Slow down |
| --- | --- |
| Being sick at TOD | Healthy at TOD |
| Young | Elderly |
| Overweight | Normal weight |
| Naked bodies | Clothed bodies |
| At 21-37 degrees Celcius | Higher temperatures (preserve bodies) |
| Moist environment | Lower temperatures (prevent bacterial growth) |
| Body found in soil | Dry environment |
| | Body found in water |

# There are 5 different stages of body decomposition.

+1. The "Fresh or Initial " Stage
+2. The "Bloated or Putrefaction" Stage
+3. The "Decay or Black Putrefaction" Stage
+4. The "Post-Decay or Butyric Fermentation" Stage
+5. The "Skeletal or dry" Stage

# Initial decay or Fresh Stage

# 0 to 3 days after death

Although the body shortly after death appears fresh from the outside, the bacteria that before death were feeding on the contents of the intestine begin to digest the intestine itself. They eventually break out of the intestine and start digesting the surrounding internal organs. The body's own digestive enzymes (normally in the intestine) also spread through the body, contributing to its decomposition.

# Putrefaction or Bloated Stage
# 4 to 10 days after death

The pig has become bloated from the build up of gases within the body.

The build up of gas resulting from the intense activity of the multiplying bacteria, creates pressure within the body. This pressure inflates the body and forces fluids out of cells and blood vessels and into the body cavity.

# Black putrefaction or 10 to 20 days after death

The pig's body has collapsed with black exposed surfaces and creamy flesh.

A large volume of body fluids drain from the body at this stage and seep into the surrounding soil. Other insects and mites feed on this material.

The insects consume the bulk of the flesh and the body temperature increases with their activity. Bacterial decay is still very important, and bacteria will eventually consume the body if insects are excluded.

# Butyric fermentation or Post Decay Stage 20 to 50 days after death

The pig is now very flat and beginning to dry out.

All the remaining flesh is removed over this period and the body dries out. It has a cheesy smell, caused by butyric acid, and this smell attracts a new suite of corpse organisms.

The surface of the body that is in contact with the ground becomes covered with mould as the body ferments.

# Dry decay or Skeletal Stage
# 50-365 days after death

The body is now dry and decays very slowly. Eventually all the hair disappears leaving the bones only.

The pig has been reduced to hair and bone.

# FORENSIC ENTOMOLOGY

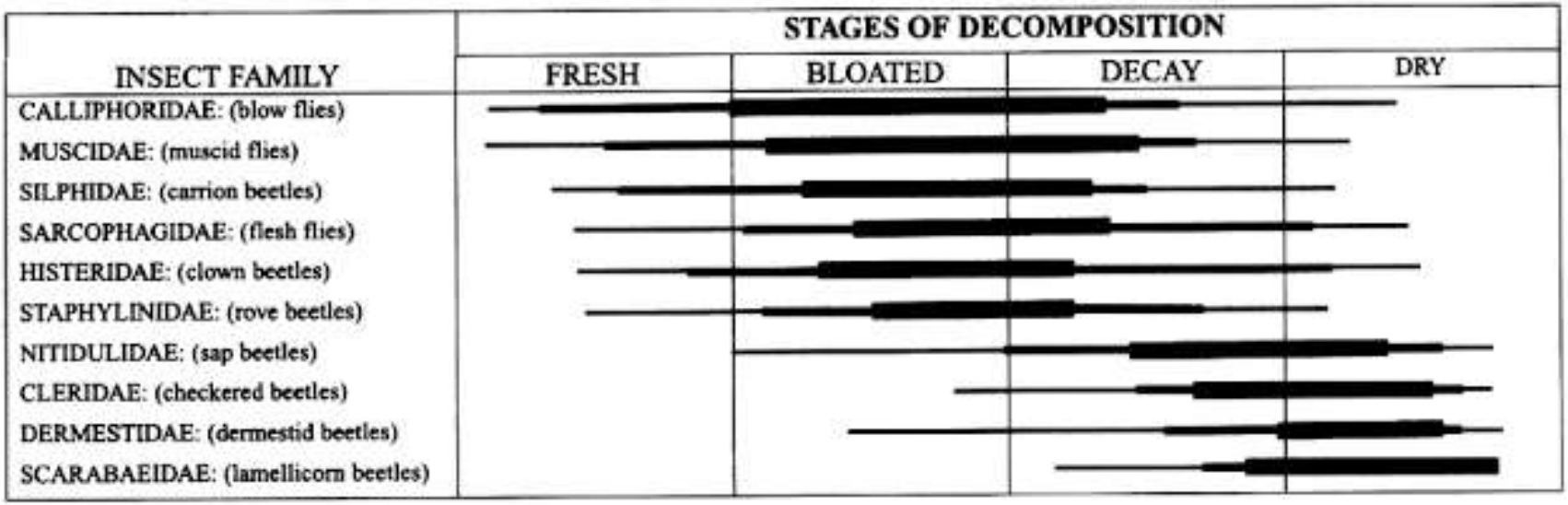
# Insects

- Insects can provide detailed information about time of death in several ways.
- There is an entire field dedicated to study insects called "Forensic Entomology".
- Within minutes of death, certain insects arrive to lay their eggs on the warm body, attracted by the smell of the first stages of decomposition.
- The eggs will hatch and feed on the tissues.
- Blowflies are a common example.
- Flesh flies are another example.

- Blowflies are attracted to two gases of decomposition:

  - Putrescine
  - Cadaverene
- As the corpse progresses through the stages, other kinds of insects will arrive.
  - Tiny wasps come to lay their eggs on maggots already present in the body
  - Cheese skippers arrive once putrefaction is underway; they are attracted by the seepage of body fluids.
  - Mites and beetles feed on dry tissues and hair.

# Common Insects at a Crime Scene




*Each stage of decomposition is given the same amount of space in this table.

Indicates a small number of individuals present.
Indicates a moderate number of individuals present.
Indicates a large number of individuals present.

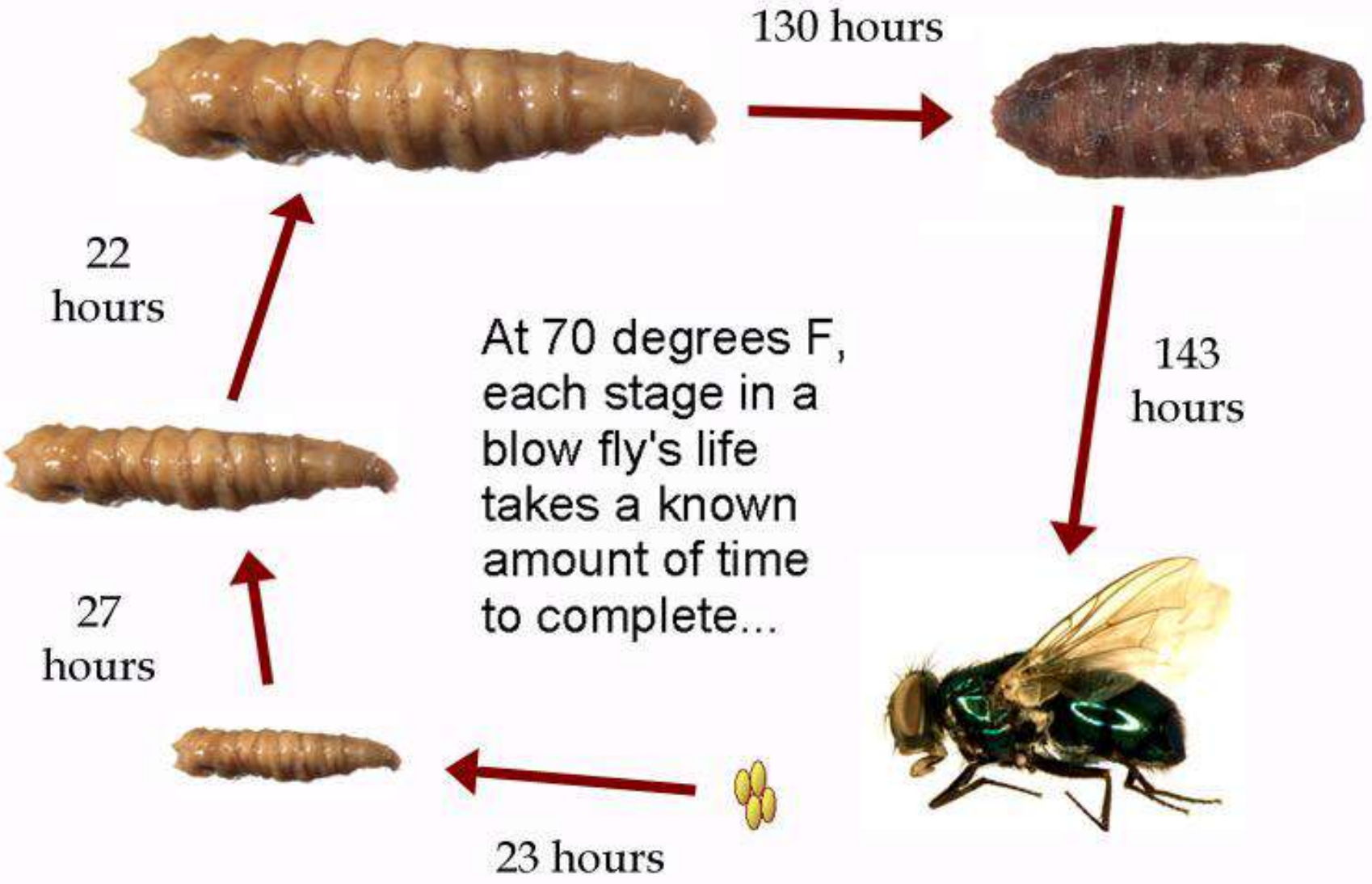
Fig. 1 Succession of adult arthropods on human cadavers in east Tennessee (during spring and summer); adapted from Rodriguez and Bass (1983) and Hall (2001)

# Blowflies

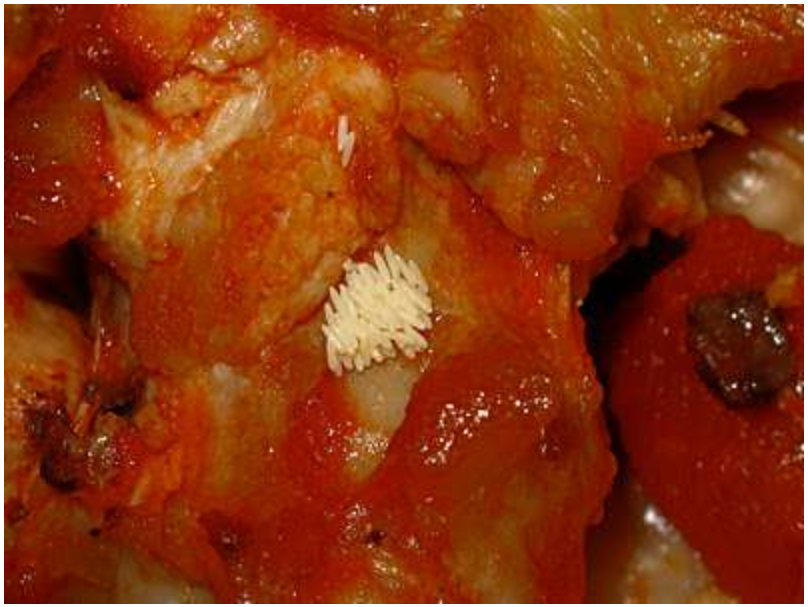
- One of the first insects to arrive at a dead body.
- Very useful in determining the TOD.
- They exhibit different stages as they develop from eggs, larva (also known as instars), pupa and adult.

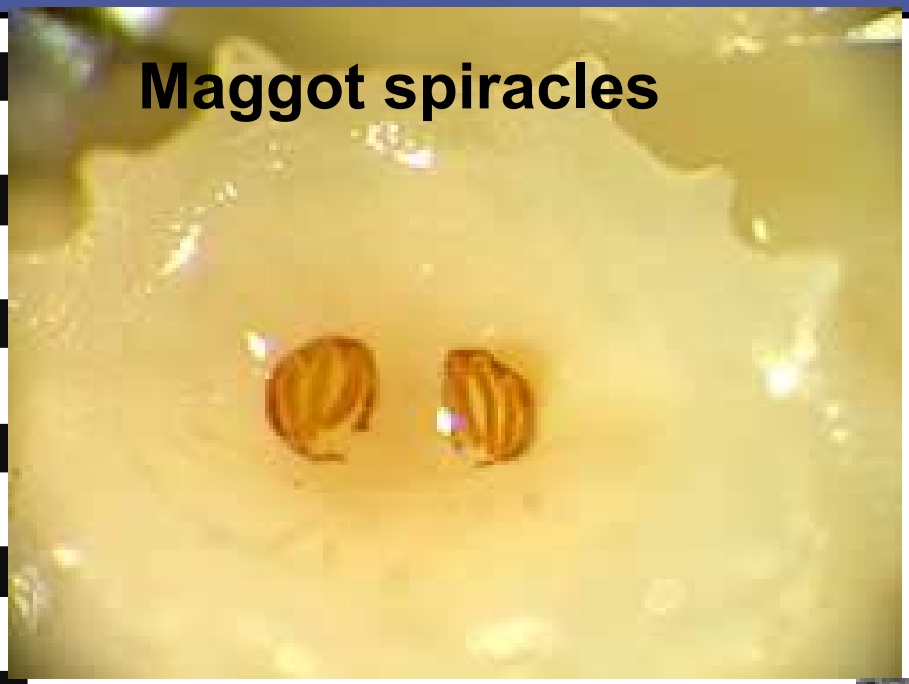

# Blowfly

The blow fly life cycle has six parts: the egg, three larval stages, the pupa, and adult.



The female lays batches of 150-200 eggs in open wounds, rotten meat, or bodies. These eggs can hatch almost immediately after being laid, but they can take up to 9 days to hatch at 5 oC. The maggost will start feeding immediately. As the duration of each of the three larval stages depend on the temperature and is known in great detail, the age of the oldest maggots together with the average arrival time of the species allows to estimate the post mortem interval and approximate time of death.






Refer to Figure 11-18

A close up of one spiracle
Electron micrograph

# Fly larvae - Maggots

First-instar

Second-instar

Third-instar

Flesh Fly - Sarcophaga bulata

Wasp

Mite

Beetles

- It's easy to identify the stage of a blowfly by noting the change in size, color, mobility, presence or absence of a crop, and number of spiracle slits. (posterior end)


Eggs are off-white, and laid in clusters of 25-500.

One-day-old larvae are only about 2 mm in length, and almost transparent.

By the time the maggots are 3 or 4 days old, they have grown to about 1 cm (1/2 inch) long.

Pupa, Adult Fly, Maggot

- If a corpse contains blowfly eggs, then the approximate time of death would be 24 hours or less.
- If a corpse contains third stage larvae, then the time of death is approximately 4 to 5 days.
- If a corpse contains pupae, then the time of death would be approximately 18 to 24 days.

- Many factors affect insect development:
  - Temperature
  - Moisture
  - Wind
  - Time of day
  - Season
  - Exposure to elements
  - Variation among individual insects

Describe ADH