METHODS FOR ESTIMATION OF TIME OF DEATH

RATE METHODS (i.e. estimation of tree's age by height / rate of growth)

- Rate of drying or discoloration of blood pools
- Rigor Mortis
- Livor Mortis
- Algor Mortis
- Decomposition
- Flora (plants) around body
- Fauna (insects) around body

CONCURRENCE METHODS (i.e. estimation of tree's age by counting rings)
- Bloodstain vs. tire
- Time of last know meal
- Stopping of watch
- Depth of footprint in snow
- Depth of rainwater collected

EVIDENCE FOR ESTIMATION OF TIME OF DEATH

1. CORPORAL EVIDENCE - In the body

2. ENVIRONMENTAL AND ASSOCIATED EVIDENCE - In the vicinity and general surroundings

3. ANAMNESTIC EVIDENCE - Based on the decedent's ordinary habits and daily activities

Corporal Evidence	Envir. and Assoc. Evidence	Anamnestic Evidence
- stage of decomp of organs vs. exterior	- uncollected milk, mail, newspapers	- usual activities
- soot in airway sleeping	- lights on / off	- walking and patterns
- medical conditions (ASCVD, pre surgery)	- alarm clock set	- eating habits, times, type of foods
- alcohol / drug levels	- food on stove / in refrig	- appointment
- beard, nails, hair	- type of clothing day / night indoors / outdoor seasonal (remote deaths) condition of clothing (mold, leached dyes)	
	- sales slips, receipts	
	- animals in house	

Use a combination of all evidence available to you, giving weight to the more reliable / documentable. Be suspicious when some factors seem to vary considerably from the others.

STAGES OF POSTMORTEM DECOMPOSITION

1. Blue-green discoloration of skin
   - RLQ and LLQ abdomen — 24 hrs
   - Entire abdomen — 36 hrs

2. Marbling (Green-black discoloration in blood vessel distribution- hemolyzed blood reacts with hydrogen sulfide.

   Extravasation diffusion (leads to generalized dark purple-black skin

3. Bloating (crepitus most marked in areas of loose skin - scrotum, penis, eyelids) — 36-48 hrs

4. Entire body decomposition — 60-72 hrs

5. Skin slippage (epidermolysis) — 4-7 hrs.
   - with vesicle formation and collapse
   - hair and nails loosen and shed
   - "glove" formation of hands and feet

6. Saponification / Adipocere — (usually several months)
   - prolonged exposure to moisture in assoc with organisms (C. Welchii)
   - involves subcutaneous fat
   - oleic acid (unsaturated/liquid) hydrogenated to stearic oleic (saturated/solid)

   Mummification
   - drying precedes or interrupts decomposition (bacterial growth arrested with body moisture less that 50%)

   Skeletonization — weeks to years

FACTORS INFLUENCING POSTMORTEM DECOMPOSITION

1. Environmental factors: Temperature
   Humidity
   Location (indoors vs. outdoors)
   Clothing
   - heat increases rate (intense heat may decrease – "heat fixation")
   - cold decreases rate
   - freezing / thawing
   - insects and soil (work from outside in)
   - micro-organisms (work from outside out)

2. Body habitus: Newborns (sterile alimentary tract) Obese vs. thin

3. Cause of death: Exsanguinations (may delay)
   Infection, CHF, anasarca (accelerates)

OSULAR CHANGES*

		eyes open	eye closed
1.	Ophthalmoscopic exam "boxcaring" in vessels ? time interval changes	--w/in 1/2 hr (indication of death) -- (ref. Kevorkian; JFS 1961)	
2.	Corneal film	minutes	several hours
3.	Scleral discoloration "tache noire"	minutes to several hours	
4.	Corneal cloudiness	2 hours or less	12-24 hours
5.	Corneal opacity		3rd PM day
6.	Exophthalmos (bulging)	--- with gas formation --	
7.	Endophthalmos (retraction)	--- advanced decomposition --	

* All depend on lid position, temperature, humidity and air currents

FOOD IN STOMACH

SIZE OF MEAL	TIME IN STOMACH (starts to empty w/in 10 min)
Light	1 1/2 - 2 hours
Medium	3 - 4 hours
Heavy	4 - 6 hours (head of meal reaches cecum 6-8 hours)

Variations:
Liquid faster than Semisolid faster than Solid

Emotional State: Psychogenic pylorospasm - prevent emptying for several hours

Hypermotility - diarrhea

(Study of condemned men following judicial execution - rate through small bowel = 6-7 ft/hr reached cecum 3 - 3 1/2 hours)

*Cannot rely on amount of digestion

EXTENSIVELY DECOMPOSED / SKELETONIZED REMAINS

Should be treated as any other case, i .e. careful examination and documentation of scene, collection of evidence, ect.

Best approach is to plan ahead (another day at this stage will probably not change the scene significantly but could make the final conclusions better).

Use the services of a forensic anthropologist liberally and early

Weathering of the bones depends considerable on

Buried or not buried
Climate
Moisture
Elevation
Terrain
Protection
Insects/animals (human) intervention

Scene conditions should be photographed, sketched, measured, etc for later interpretation. Collect plant when appropriate. Check weather bureaus for rainfall, temperatures, etc.

Interpretations must take into account the local conditions -- results vary widely with different areas of the country.

INSECT INFESTATION (FAUNA) = Useful for establishing a minimum postmortem interval

1. Body lice - outlive host by 3-6 days

2. Blow flies (diptera) - may deposit ova before or at death
   - larva (maggot) - hatch 18-24 hours (strongly proteolyticmay exaggerate size/ obliterate penetrating wounds)

3. Insect / arthropods (temp greater than 40 F)

- Highly dependent on locale, temperature, season

* Collect representative samples in preservative (85% alcohol) and take to an entomologist

PLANT LIFE (FLORA)

1. Grass / plants beneath an object wilt, turn yellow or brown and dies (rate depends on type of plant, season, climate, etc.)

2. Seasonal plants or remnants may help indicate a range of time

3. Collect dead and dying grasses, twigs, flowers, etc. and take to a local botanist

LIVOR MORTIS

(SYNONYMS: POSTMORTEM HYPOSTASIS, LIVIDITY, SUGGILLATIONS, GRAVITATION)

Know since antiquity, the settling of blood to the dependent parts of the body has been recognized as a change of death. When cardiac activity stops the hydrostatic pressure of the liquid blood causes it to settle and distend the dependent capillary bed. The color of the dependent part will depend on the skin pigment and any additional compounds in the blood that may affect color, such as carbon monoxide, but it is generally dark blue or purple.

Livor begins at or very soon after death since it is a function of blood flow and, therefore, cardiac activity. However, stasis can occur to some extent in shock and some degree of lividity can be present even while a person is technically alive.

MECHANISM	ONSET	MANIFESTED	MAXIMUM	DISAPPEARS
SETTLING	IMMED	2-4 HOURS	8-12 HOURS	----------

There are factors that will accelerate or retard the onset of visible livor, and the disappearance rate is similarity variable.

TARDIEU'S SPOTS

When the accumulated area engorged with blood is large, gravity can cause capillaries in a small area to rupture so that larger, usually circular or rounded areas of skin hemorrhage occur. These have to be differentiated from the much smaller petechial hemorrhages more suggestive of asphyxia. Size is important since these areas are usually 405 mm or larger in diameter, whereas petechiae are usually 1mm or smaller in diameter.

Livor will not usually develop where there is pressure from clothing or object so important information regarding whether a patient was clothed for a period of time after death or if his position was changed can be gained from a careful inspection of livor's distribution. Generally, time can at best be supported from observation of livor and comparison with the accelerating or decelerating factors affecting that scene.

TIME OF DEATH ESTIMATES

LIVOR MORTIS:

FACTORS:

* CIRCULATORY FAILURE (STAGNATION)
(SKIN LIVID PRIOR TO DEATH)

* CHRONIC ANEMIA - OR ACUTE BLOOD LOSS -
LIVIDITY LESS MARKED

* CARBON MONOXIDE POISONING

* CYANIDE POISONING

* CASE OF RAPID COOLING - SNOW - WATER

"TARDIEU'S SPOTS" OVER CONGESTIN OR = BLOOD IN

PETECHIAE CAPILLARIES

RATE:

VISIBLE - 1/2 TO 4 HOURS
WELL-DEVELOPED 3 - 4 HOURS
MAXIMUM 8-12 HOURS

RIGOR MORTIS

One of the classic markers of death, its normal sequence is well documented in history. In Michelangelo's famous status of Christ's being take from the cross, the flaccidity typical soon after death is clearly evident. Muscular relaxation immediately after death is followed by the onset of gradual rigidity without shortening of the muscle. Since muscle continues to metabolize for a short time after somatic death, or from products built up during the death event, glycogen is converted into lactic acid. As the pH falls, there is a physical change in the muscle protoplasm. Since there is no regeneration of ATP in dead muscle, this process proceeds in one direction only. The sol is converted into a gel as the actin of the muscle is physically changed.

Perception of rigor is more rapid in the smaller muscles, leading to the misbelief that this process started in the head and worked down the body. All muscles are affected at a similar rate; rigor is more evident in the short, smaller muscles earlier than in the longer, larger muscle masses.

Since this is a chemical process, heat accelerates and cold decelerates the process. Acidosis, uremia or other medical conditions promoting a lowered pH accelerate the process.

The very perception of rigor depends on experience and condition. A very cold body may appear stiff because of changes in the fat layer.

MECHANISM	ONSET	MANIFESTED	MAXIMUM	DISAPPEARS
Physical chg.	immed	1-6 hours	6-24 hours	12-36 + Hrs.

Rigor is typically quantitated by mild or early, moderate or mid and full or complete as a descriptive statement of degree of change. This is totally subjective, and two observers may have different interpretations. Usually, perceived stiffness in motion of a joint is mild, difficulty-requiring force to move a joint is moderate, and having to use great force is full rigor.

One the physical change of the muscle is forced, that degree of change will not reoccur, so that if someone has broken the rigor, it will not reform if to completion. If only partial, some rigor will continue to form.

This is an unreliable method of indicating the time of death. It is affected by illness, temperature, activity before death, and the physical conditions where the body is placed or found. It may be poorly formed in the young or the old. It is an aid in the general determination of death at best, and should not be relied on as a single indicator of the time death.

TIME OF DEATH ESTIMATES

RIGOR MORTIS - (STIFFENING OF MUSCLE TISSUE)

GENERAL RATES: ("AVERAGE CLOTHED ADULT")

OBSERVABLE IN SMALL MUSCLES FIRST

DETECT - 2 TO 4 HOURS
COMPLETE - 6 TO 12 HOURS
REMAINS - 12 TO 18 HOURS
BEGIN TO LEAVE - 24 TO 36 HOURS
GONE - 40 TO 60 HOURS

EXCEPTIONS - HAS BEEN GONE IN 9 TO 12 HOURS
STILL IN - 45 TO 60 HOURS

FACTORS: ODY TEMPERATURE AT DEATH
HIGH / LOW ENVIRONMENTAL TEMPERATURE
EAT - HASTENS
OLD - RETARDS
STRENUOUS MUSCULAR ACTIVITY
EMOTIONAL EXCITEMENT

ALGOR MORTIS (Cooling after Death)

The metabolism of the tissue generates heat, which is very tightly regulated by the body to a narrow range. Cooling of the body after death is another of the classic markers of death. If the body always cools at a uniform rate, then that slope would enable an accurate determination of the time of death.

However, the body temperature is a narrow range not a fixed temperature. Activity, illness, decomposition, infection and absorption of heat can maintain or raise body temperature after death. The body cools by radiation, convection and direct transfer, so that any facts that influence heat loss affect rate. Careful consideration of the scene, clothing, patient size and activity and physical factors have to be considered in interpreting cooling rate.

Over the years, there have been a number of formulas proffered that would, in theory allow the calculation of the time of death.

(Glaister) $\frac{98.4 - \text{measured rectal temperature}}{1.5}$ = hours since death.

In Fatteh is the statement that the cooling of the body is the most reliable factor for the first 12-18 hours, but he points that exercise or struggle could raise the temperature from 9 by 3-4, sleep lowers etc. He included the warning that degree of fatness, age, ventilation all changed the rate, and that clothing was 66% slower and water 2X as fast.

Marshall and Hoar, in a series of articles on this topic stated that the rate was not uniform, but 1/hr for the first three hours, then 2/hr for the next six hours then 1 ½ hours for the next three, etc.

Spitz and Fisher caution that they had observed cases where 93 was reached in as short a time as 2 hours and as late as 6 hours. Temperature has to be considered insight of all the scene data, consideration for any altering factor, and then carefully. For example, a person dead in a closed car all day with the sun shining on the car who is then observed at night could not be expected to cool in a regular fashion, and in fact may well have an elevated or normal temperature.

TIME OF DEATH ESTIMATES

Algor mortis – (BODY COOLING)

GENERAL RULE:	1.5 DEGREES PER HOUR – WHEN ROOM TEMPERATUE IS ABOUT 70 DEGREES
DR. SIMPSON:	2.5 DEGREES AN HOUR FOR FIRST 6 HOURS AND AVERAGE 1.5 TO 2 DEGREES LOSS PER HOUR OVER FIRST 12 HOURS
DR. RHODES, GORDON AND TURNER:	1.5 DEGREES FOR FIRST 12 HOURS AND 1 DEGREE FOR NEXT 12 TO 18 HOURS
FACTORS:	BODY TEMPERATURE AT TIME OF DEATH BODY SIZE (FAT SLOWER, CHILD FASTER, ECT.) CLOTHING OR COVERING ENVIRONMENTAL TEMPERATURE (WIND, HIGH HUMIDITY INCREASE EVAPORTAION OF WATER AND HASTEN
COOLING	IMMERSION IN WATER (GOOD CONDUCTOR)

VITEOUS POTASSIUM

A study of cell physiology revealed that he cell maintains an increased concentration of potassium in the intracellular fluid, 20 to 40 times the concentration in the plasma. This high concentration requires a balance between the electrical charges inside and outside the cell membrane and is maintained in this relatively high concentration by active metabolic forces that "pump" the electrolytes selectively across the membrane. A return to equilibrium occurs after death at a steady rate because the pumping mechanism is no longer active and the cell wall now becomes a semipermeable membrane that allows the potassium to leak through the membrane to approach equilibrium. The leak is at a steady rate because of the mechanical limits of the membrane. This steady rate provides a built-in clock that allows a projection back to the time of death. Since blood hemolyzes and loses potassium, it becomes unreliable for analysis. An ideal sample, protected from most traumas, is the vitreous fluid of the eye.

Sturner and Gantner developed a formula for estimating time of death based on a uniform K+ leak rate of 0.14 mEq/L/hr. The formual is:

$(7.14 \times 8.1) - 39.1 = 18.7$ or approximately 19 hours since death.

Coe published similar findings. Soon after this data was published the formula was found inapplicable for some locations and/or situations. The authors and Dr. Coe suggest that you determine the rate of your specific area, and you may require different charts for different seasons. The concept is valid, but it has to be interpreted in light of regional variations and with consideration for accelerating or decelerating factors.

BOMBS

Some facts about bombs

1. Most common targets – home, vehicles, and businesses
2. Most bomb (3/4) are pipe bombs with black smokeless powder
3. Most common motive was revenge or vandalism (others are protection, attention, political reasons)
4. Changes in recent acts – Bombs roses 54% from 85-89
   Main bombings on the rise
   Narco-bombings

What are the types of explosions – based on the characteristics can identify character of explosion even with no traces of explosives left

1. low – push effect
   low frequency sound
   absence of severe damage
   Gunpowder, gasoline, and carbon monoxide
2. high – seat of origin
   high frequency sound
   crater / severe damage
   dynamite, nitroglycerine

Bomb scenes just like arson have a number of problems that must be dealt with

1. Scene search – often dependent on type of explosives
   a. low – out
   b. high – down and out
2. must be looking for trace evidence – wires, metal, residue etc.
   needed to answer the questions

Questions, which need to be answered in, bomb investigations – these can help us in often identifying the nature of the criminal

1. Target – person, property, activity
2. Opportunity – capability, means, knowledge and access
3. Means – what explosive materials, mechanisms, can camouflage was used
4. MO – technique, tactic, or method of operation

Evidence connecting suspect to bomb is imperative

1. person – material on them
2. place of work or home – materials found in either place
3. Vehicle – used for transportation, tools
4. Source of explosives

Ask witness sensory questions

1. How many explosions did you hear
2. Color of smoke
3. Odors

A. Types of explosions
B. Crime Scene Actions
   *Need to find evidence, which establishes corpus delich
   1. Define scene
   2. Documenting scene
      a. photos – markers one with and one without
      b. sketch
      c. notes
   3. Searching scene
   4. Examination of victims
   5. Utilities
C. Nature of the criminal
   Criminal – hard
   Vs.
   Noncriminal - easy

Factors used in helping to identify animal.

BURGLARY

Two basic types of burglaries:

RESIDENTIAL	COMMERCIAL
OPPORTUNISTIC	DELIBERATE
*Change targets	* Prefixed targets
* newspapers, mail	* According to needs
PLANNING	
* Little Planning	*Usually much planning
*Often "Loner"	*Accomplices, lay-outs, fences, etc.
RISK	
*Soft targets, few deterrents	*High Risk
*Soft punishment	*Guards, alarms, guard dogs, police patrol, etc.
RETURN	
*Low return usually	*High return
*Whatever available	*Specialized "fruits" jewelry, narcotics, valuable on large scale
*Low income targets	*High priced targets

Fire in order to exist must have two elements – source of heat and material ignited

Elements of the crime – burning, dwelling, malice

Fire is one of the most difficult crimes to investigate because there are numerous accidental causes of fire.

1. electrical system
2. electrical appliance and equipment
3. gas
4. heating units
5. sunlights
6. matches
7. smoking
8. spontaneous heating and ignition
   chemical action, fermentation, oxidation

Examining the burn can help determine if it is arson – each of the following examples help indicate the speed of the heat and fire

1. alligatoring effect – checking the wood – large rolling blisters indicate rapid intense heat.
2. Crazing of glass – formation of irregular cracking in the glass
3. Dept of char – natural fire burns about 1" every forty-five minutes
4. Line of demarcation – puddle look of a burn indicates an accelerant
5. Sagged furniture springs
6. Spalling – breaking off of stone indicates high heat, brown stain around breakage indicates accelerant
7. Freezing of leaves – can help determine when the fire started

Who set fires
1. arsonist
2. pyromaniac

Motives for arsonist
1. economic gain
2. concealment of a crime
3. punitive
4. intimidation or economic disabling

Pyromaniac – this is a disease / a mental affliction and not a motive.

LARCENY SPECIALTIES

(This list specifically DOES NOT include the crimes of Burglary, Forgery, High Jacking or Robbery as well as other forms of Theft.)

Art Theft

Auto Theft
- Larceny of
- Larceny from
- Parts

Bicycles

Larceny of
Parts

Confidence Games
(Fraud, Bunco, Swindles)

- Art Fraud
- Auto Repair
- Badger Game
- Charity Fraud
- Creepers
- Diamond Switch
- Green Horm Swindle
- Home Improvement
- Jamaican Bunco
- Medical Quacks
- Money Making Machine
- Phony Bank Examiner
- Phony Horse Parlor
- Pigeon Drop
- Platinum Fraud
- Shell Game
- Short Change Artist
- Sick Mining Engineer
- Sir Francis Drake
- Smack Game
- Spanish Prisoner
- Stock Swindles
- Three Card Monte

Credit Card Theft

Embezzlement

False Pretenses

- By Check
- By Fraud (above)

Hotel Thefts

Jewelry Thefts

Loan Sharking

Lush Workers

Mail Box Thefts

Pick Pocket

Pilferage (Employee)

Possession / Stolen Goods

Purse Snatch (Non-violent)

Receiving Stolen Goods

Shoplifting

Till Tap

Unauthorized Use

Window Smashers (commercial)