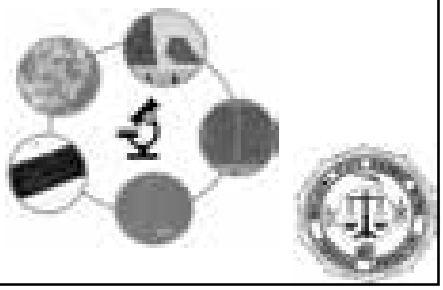
Introduction to Trace Evidence



Course Objectives

- Define trace evidence
- Describe various types of trace evidence
- Describe collection & preservation of trace evidence
- Describe collection of standards and controls
- Discuss examinations and limitations of trace evidence

What is Trace Evidence?

- The study of small object transfer
- Mostly comparisons and characterizations
- Often very small and almost always very fragile
- Based on Locard's Exchange Principle

Locard's Exchange Principle

- A cross-transfer of material occurs when a person or object comes into contact with another person or object- "every contact leaves a trace"
- "The microscopic debris that cover our clothing and bodies are the mute witness sure and faithful of all our movements and encounters" –Locard, 1929
- An indication of a prior presence or activity

Goal in Trace Evidence

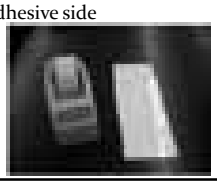
- Associate
  - Person to person
  - Person to place
  - Person to object
  - Object to object

Types of Trace Evidence

- Comparison Evidence
  - Hair
  - Fiber
  - Paint
  - Soil
  - Glass
  - Tape & Plastics
  - Misc. comparisons
- Identification Evidence
  - Gunshot residue
  - Flammable liquids
  - Explosives
  - Unknown substances
    - White/other powders
    - Liquids (acids/bases/antifreeze)
    - Stains (oils,wax)
  - Filaments (on/off)
  - Fracture/Physical Match

Evidence Collection

- Manual—if visible, place on tape/Post-It
- Tape lift (frequently best method)
  - Effective
  - Roll or sheets, Post-It Notes
  - Tape placed on clear plastic sheets or bags
  - Do not stick adhesive side to adhesive side
- Vacuum
  - Most thorough…but…
  - Too much debris often masks evidence



Evidence Collection—a two step process

- Collect questioned samples
- Collect comparison standards
  - Hair—suspect & victim
  - Fiber—carpeting, upholstered seats, submit clothing
  - Paint—residence, vehicle—suspect & victim

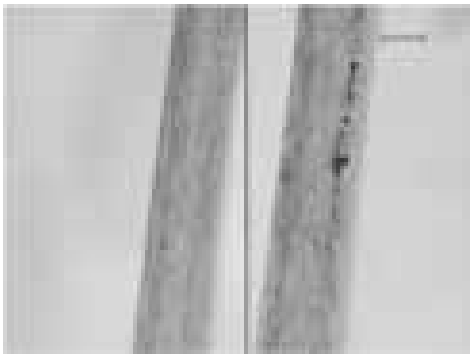
Hair Examinations

- Microscopic comparisons
  - Head or pubic hairs only
  - Requires hair standards
  - Class evidence: Hairs are not individualistic
    - "Could have come from …"
  - Scenario is all-important
    - Hairs from people residing together not probative
- Screen for nuclear DNA and mitochondrial DNA

Hair Examinations

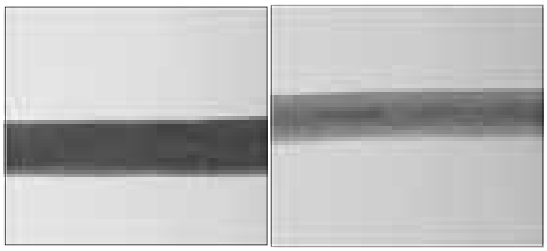
- Hair standards
  - 50 hairs from different areas of head-envelope
  - 25 hairs from pubic region-envelope
  - Comb or pulled—must have root
  - DO NOT CUT
  - Collect as soon as practical; hair changes w/ time
- No need to collect chest, beard or any other body hairs

European Head Hair Comparison



European Head Hair

These are from the same person--demonstrates why a standard should include 50 hairs

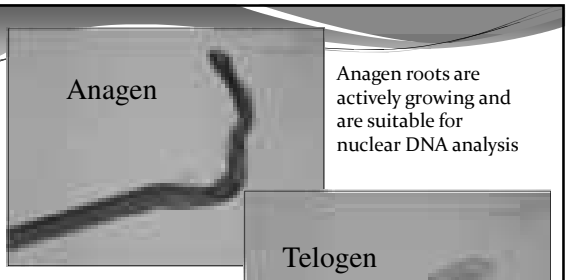


Hair Examinations

- Microscopic Examinations
  - Human vs. animal
  - Can usually determine ancestry and body origin
  - Can determine if root useful for nuclear DNA—any body origin
  - If not, should be about 1 cm or more in length for mitochondrial DNA
    - Any body origin
    - Performed at FBI labs; no charge

Hairs Suitable for nuclear DNA

- Depends on growth phase of hair
  - Assessed microscopically, must have a root
  - Most hairs at scene are shed (telogen)…often not useful
  - Pulled hairs (anagen) most likely useful
- Same kind of result as if DNA came from blood
- Mitochondrial DNA not nearly as specific



Anagen roots are actively growing and are suitable for nuclear DNA analysis

Bare telogen roots are shed and are not suitable for nuclear DNA

Fiber Collection

- Tape lift or manual (tweezers) collection
  - If you can see it, collect it – post-it note, tape lift
  - Tape lift bodies, vehicle interiors
  - Collect clothing, bedding that could have contacted victim or suspect
- Lab exams: visual, taping, shaking/scraping, alternate light source
- Need fiber standard from suspected sources
  - Often collected later as suspect developed

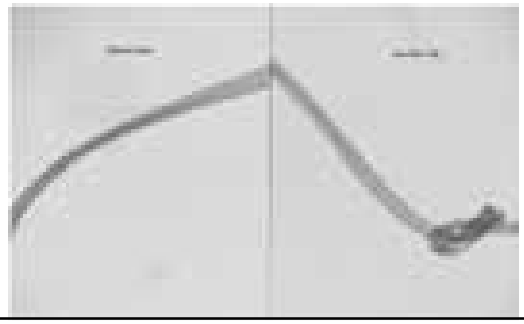
Fiber Examinations

- Questioned fibers can be identified as to type, e.g., nylon, polyester, acrylic, Kevlar
  - Uses not always clear
  - Carpeting often deduced based on shape
- TV CSI-type fiber databases do not exist

Fiber Comparisons

- Compare standard fiber to questioned fiber
  - Microscopy- compare shape, color, dimensions, optical properties
  - Microspectrophotometry – can distinguish between fibers that look the same color but use different dyes
  - Infrared spectroscopy – compares chemical make-up and confirms fiber type
- If not different they may have a common origin; fibers are mass produced
- Arise from hit & run, burglary, homicide, assault

Fiber Comparisons



Paint Examinations

- Paint can be found on a large number of surfaces, architectural, automotive or implements
- Common in burglary, hit & run, homicides
- Paint comparisons of evidentiary value:
  - Transfers on tools to home or business in cases of burglary or destruction of property
  - Transfers on hit & run vehicle to suspect vehicle or pedestrian
  - Painted objects such as bats and metal tools used to assault someone can transfer paint to victim

Paint Examinations

- Paint typically multilayered
- Colors, layers, chemical composition compared
- Chemical analysis allows for some sourcing, e.g., architectural, automotive OEM vs refinish
- Good class evidence

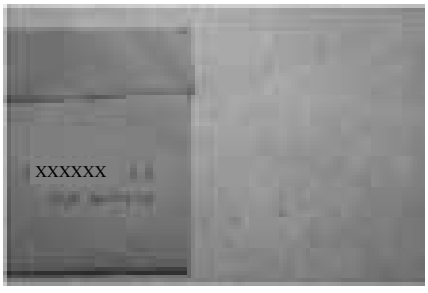
Paint Collection & Preservation

- Questioned paint collected as scrapings or item (e.g., tire tool) with paint transfer submitted to lab
  - Collect transfer with razor blade → paper fold
  - If that fails, try tape lifting transfer
- Not always readily apparent by naked eye – clothing
- Collect standards—all layers; collect down to substrate
- If from vehicle, collect from damaged area(s) and surrounding body parts

Paint Collection & Preservation

- Place each collected sample in separate containers and seal
  - Paint scrapings are often quite small
  - Make sure paint samples cannot escape
  - Tape over seams in envelopes
- Questioned and known paint samples should not be placed in the same container even when in separate containers

Paint flakes can escape packaging



Packaging
Hair, Fiber, Paint, Glass

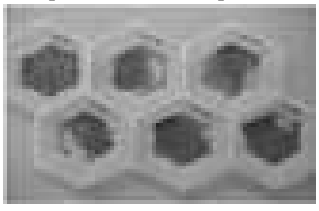
- Hair/Fiber—paper folds, envelopes (esp. standards), ziploc bags, boxes, Post-It Notes→envelope
- Paint/Glass—paper folds, well sealed envelopes, metal canisters, plastic pill-type containers
- Items (e.g., clothing) packaged together will be treated as if hair came from any one of them

Soil & Glass

- Good class evidence
- Typically used to place suspect at a scene
- Examined for color and microscopic characteristics
- Like other trace evidence types, random sources usually different

Soil

- Compare color, mineral content, extraneous materials
- Standard soil samples should consist of just top ¼ inch, need about 1 fluid oz or more
- Collect multiple standard samples from suspected area



Soil Examinations

- Typically compare soil from suspect item to soil at scene.
  - shoes
  - clothes
  - vehicle
  - shovel

Examination of Glass Fragments

- Most random sources of glass can be differentiated by their physical properties:
  - color
  - thickness
  - density
  - refractive index
  - bulk elemental analysis

Foreign substance/substance Id

Types of Cases
- Poisoning
- Tampering
- Suspicious/Unknown substances

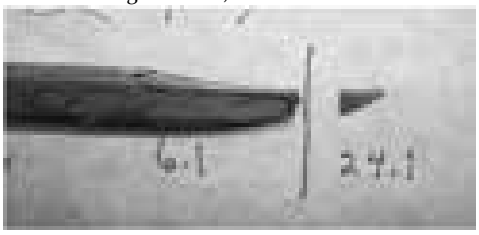
Examples of substances that can be detected:
- Bleach
- Acids
- Sugar
- Arsenic
- Anti-freeze

Use a variety of instruments, spot tests, and microscopy to attempt to identify foreign substances.

Substance ID-makeup on airbag

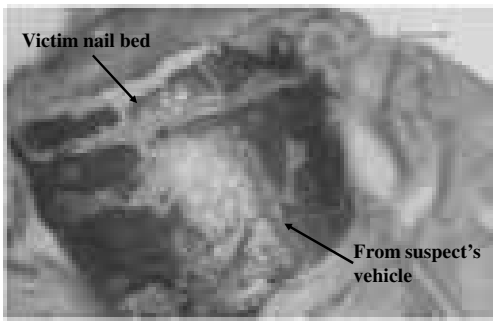
Physical Match

- Any thing torn or broken can be physically matched together
- Individualizing evidence, best kind of trace evidence

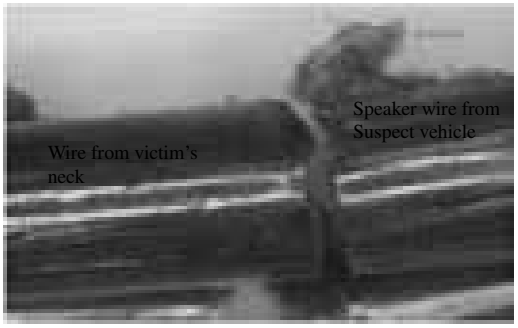


Physical Match

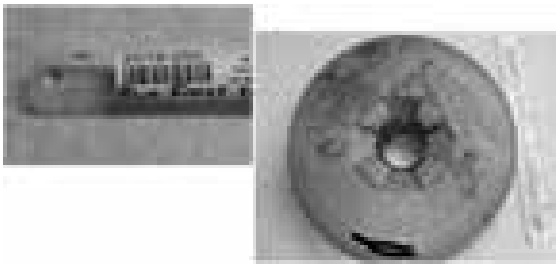
Broken fingernail matched to victim



Physical match of Wires with plastic sheaths

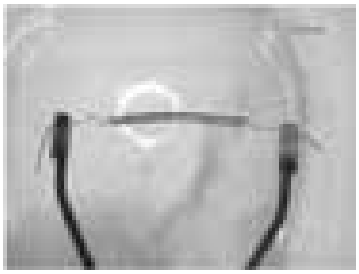


Physical characteristics comparison

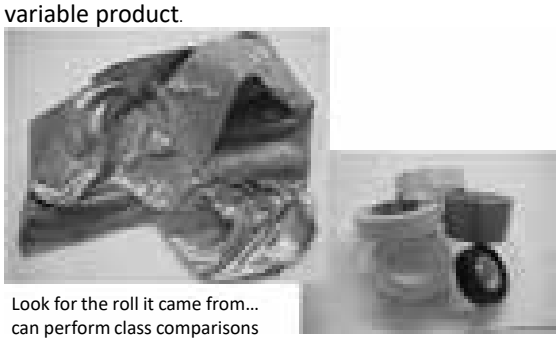


Filaments

- Determine if lamp was on at time of impact

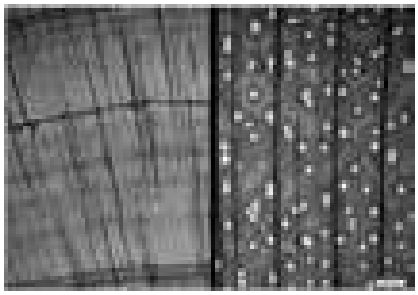


Not only is tape a trace "magnet" but it is a highly variable product.



Look for the roll it came from…
can perform class comparisons

Wood Comparison—Identify to species



softwood hardwood

Flammable Liquid Analysis

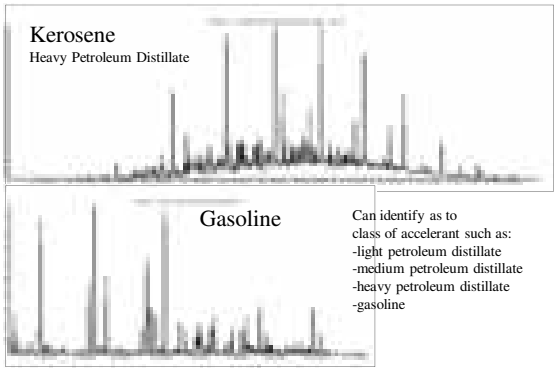
Ignitable Liquid Residues

Evidence Collection: Arson Investigations

- Evidence submitted where arson may be involved has to be in a vapor tight container such as unused paint cans or Mason jars
- Use only polyester or nylon bags. They should be heat sealed as well.
  - Ziploc bags are NOT air tight; do not use Ziploc bags.



Analysis by Gas Chromatograph-Mass Spectroscopy (GC-MS)



Can identify as to class of accelerant such as:
-light petroleum distillate
-medium petroleum distillate
-heavy petroleum distillate
-gasoline

Limitations of exams

- Ignitable liquids (arson)
  - What it can do
    - Illustrate presence of an ignitable liquid
    - Provide comparison to known standard
  - What it can't do
    - Source of liquid
    - "Ignitable liquid" vs. "Accelerant"
    - Packaging is all-important

Explosives

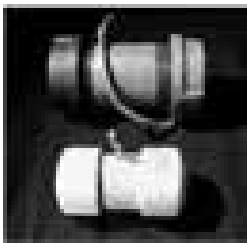
Types of Explosives

- Low Explosives
  - Black powder
  - Black powder substitutes, e.g., Pyrodex
  - Pyrotechnics, e.g., flash powder
  - Smokeless Powder
- High Explosives
  - TNT
  - C-4
  - ANFO
  - Dynamite

Goal: Identify the explosive or explosive residue

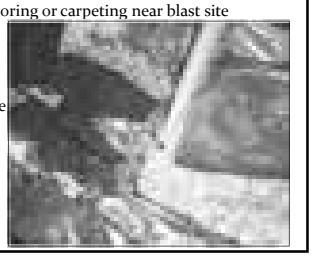
Improvised Explosive Device

Intact devices need to be made safe prior to submission
Submit only 2-3 grams of material (2-3 tsp) in antistatic bags or metal cans



Post-blast debris collection

- Collect any remains of device → bags, boxes, cans
- Collect any visible residues in blast site → cans, plastic screw cap vials/bottles
  - May be mixed in soil or concrete, etc.
- If blast occurs in residence or vehicle
  - Collect cushions/upholstery, flooring or carpeting near blast site
  - Place in bags, boxes or cans
- If high explosives suspected, all evidence requires air tight containers like flammables evidence

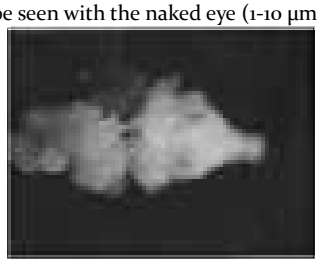


Gunshot Residue (GSR)

- Originates from the primer of ammunition
- Lands on hands of shooter
- Detection of GSR on hands of suspected shooter places him/her in close proximity to a discharged firearm

SEM/X-ray Analysis of GSR

- Primer GSR consists of lead styphnate, antimony sulfide, barium nitrate
- Deposits and adheres to hand after firing
- Cannot be seen with the naked eye (1-10 µm diameter)



The Gunshot Residue Kit

- Fill out information on data sheet
  - Caliber of weapon
  - Type of ammo
  - Est. time since shooting
- Wear gloves
- Start at webbing between thumb & index finger
- Firmly dab hands until adhesive no longer tacky
- The adhesive of the tape picks up the GSR particles

Sampling Considerations

- Administer as soon as practical
  - 4-6 hours after shooting GSR particles wiped off
  - Don't expect GSR after eight hours (won't analyze)
- Gunshot residue is easily removed by wiping or washing
- Collect prior to fingerprinting

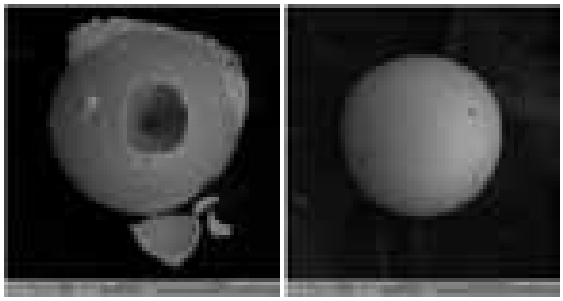
SEM/EDX Analysis of GSR

(Scanning Electron Microscope/Energy Dispersive X-ray Spectrometer)

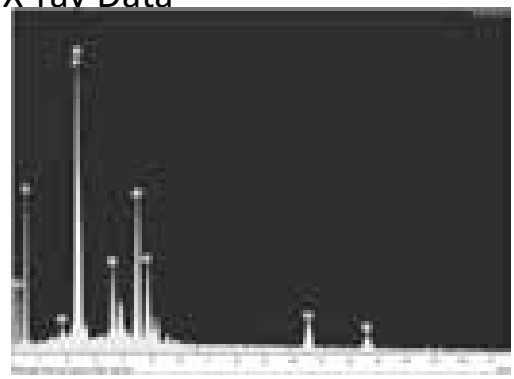
SEM/X-ray Analysis of GSR

- Place stub in SEM
- Automatically searches stub for particles that are characteristic of GSR.
- These particles have
  - Pb/Ba/Sb

SEM Image of GSR Particle



X-ray Data



What does a positive result mean?

- Person discharged a firearm
- Person handled a firearm or another item with GSR on it (wound, clothing, cartridge case, holster)
- Person in close vicinity to a firearm when it discharged
  - Has been detected up to 12 feet around shooter and follows the path of the bullet downrange.

What does a negative result mean?

- Person did not discharge a firearm
- Person discharged a firearm but
  - gunshot residues were not deposited in a detectable amount
  - gunshot residues deposited but wiped off prior to collection
  - gunshot residues deposited but not transferred to adhesive stub

GSR Analysis Limitations

- Cannot determine if a person actually fired a weapon
- Cannot determine if a person did not fire a weapon (negative does not mean elimination)
- Detects the residues but does not determine how they got there

Scenarios

- Two subjects wrestling/playing with gun. Gun discharges, one gets shot. Unclear as to who fired weapon.
- Is GSR testing going to answer the question as to who shot the firearm?

No

- Regardless of which subject actually pulled the trigger, both subjects in vicinity of firearm when it discharged.
- Both may have GSR on their hands.
- GSR may not have deposited on either or been wiped off of either.

Scenarios

- Shots fired from vehicle. A driver and three passengers apprehended two hours later. Unclear as to who shot firearm. No weapon found.
- Is GSR testing of the four subjects going to answer the question as to who, if anyone, shot the firearm?

No

- All were in the vehicle and, therefore, in the vicinity of a discharged firearm
- Any or all may have GSR on their hands
- GSR may deposit on interior surfaces of vehicle and then transfer to occupants
- Potentially, actual shooter could test negative while others test positive

Kits from Suspected Suicides

- If there is a gunshot wound, victim was obviously in the presence of a discharged firearm.
- Victim can test positive regardless of who pulled trigger.
- A negative test does not mean that someone else shot the victim.
  - 15-20% of suspected suicides test negative

Kits from Homicide Victims

- Victims with gunshot wounds from known homicides test positive for GSR about often as suicides
  - This demonstrates that a positive result on a suspected suicide does not mean the fatal shot was self-inflicted.
- Even after a bullet passes through a window, GSR particles can still be found on clothing of a victim of a shooting.

Homicide Victims

- There is usually no reason to analyze kits from a homicide victim
  - Cannot be used to rule out/rule in suicide
  - Cannot determine defensive posture of victim (hands at side vs hands protecting face, etc.)
  - Cannot be used to determine shooting distance
- We do not routinely test GSR kits of shooting victims (suicide, homicide or assaults)

Kits from "Eliminations"

- People near the discharge of a firearm can have GSR on their hands.
- People entering room after shot discharged may have residue on their hands from contacting surfaces in room or on body
- A negative does not mean they did not fire a weapon

GSR Sampling of Inanimate Objects

- Sampling of clothing, cars, etc.
- Don't know how long GSR has been there: is it related to the shooting incident in question?
- Even laundered clothing can retain GSR
- GSR can transfer from one clothing item to another

GSR Sampling of Inanimate Objects

- Sampled steering wheels of three firearms examiners.
- All three steering wheels had GSR on them.
- In each instance, it was several days since examiner discharged or handled firearm.
- GSR on steering wheel due to transfer; firearms not discharged from vehicles.

So when is GSR useful?

- Some labs think it is not worth the time & money to analyze for GSR
- Can help corroborate or disprove a scenario
- Best case scenario: suspected shooter denies firing a weapon, handling a weapon or being near a weapon when it discharged
- If positive for GSR it warrants a further investigation

Reminder: Trace Evidence needs STANDARDS

Used for comparison to questioned items; hair, fiber, paint, glass, etc. to eliminate OR associate a given person to a crime.

Also referred to as: controls, knowns, exemplars.

Collecting Standards

- Head Hair—50 pulled/combed from different areas of head
- Pubic Hair—25 pulled/combed from different areas of pubic region
- Fiber—carpet, clothing, upholstery, blankets
- Paint/glass—automotive, architectural
- Foreign substance—sample of unadulterated product; sample of what substance is thought to be
- Misc. comparisons—cosmetics, lubricating creams, paper, plastic, trash bags

Questions

? Comments !

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DNA Collection, Processing, & Analysis

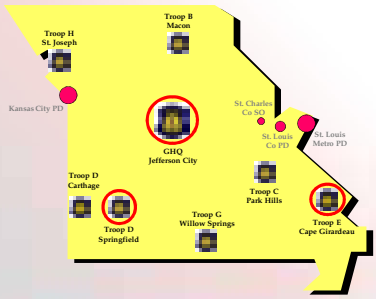
Missouri State Highway Patrol
CODIS, Casework, & Y-Screening DNA Sections

POST Control # 22037

Objectives

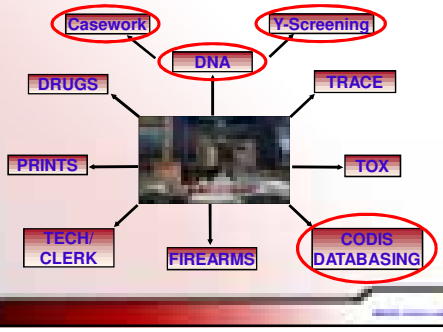
1. Identify which Missouri State Highway Patrol labs offer DNA analysis.
2. Explain the differences between the CODIS, Casework, & Y-Screening sections.
3. Define DNA & identify good sources of DNA for evidentiary purposes.
4. Discuss collection, packaging, & submission of DNA evidence & reference standards.
5. Explain the DNA Case Acceptance Policy.
6. Explain CODIS eligibility information requirements.
7. Explain the process of DNA profiling, comparisons, & reporting.

MSHP Laboratory System



- *DNA testing at 3 MSHP labs*
  - *Jefferson City (Q)*
    - *Casework, Y-Screening*
  - *Springfield (D)*
    - *Casework (including Y-Profiling)*
  - *Cape Girardeau (E)*
    - *Casework*

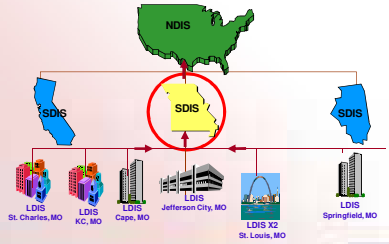
MSHP Laboratory System



CODIS (Databasing) Section

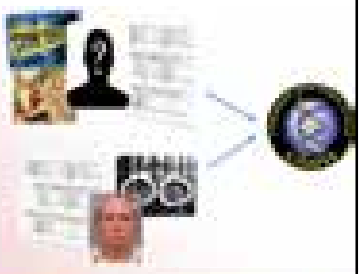
Combined DNA Index System (CODIS)

enables local, state, & national forensic labs to electronically compare DNA profiles



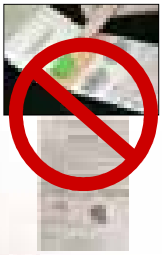
CODIS (Databasing) Section

- State repository for all offender samples (>350,000) collected pursuant to RSMo 650.055
  - Databasing purposes only
  - Required by statute
  - No right of refusal
  - No chain of custody
  - Offender collection kit
  - Mailed to CODIS unit



CODIS (Databasing) Section

"I don't have a buccal swab, but the guy's in CODIS."



- Casework ***DOES NOT*** have access to these samples or profiles.

THESE SAMPLES ARE NOT EVIDENCE
THESE SAMPLES CANNOT BE USED IN CASEWORK

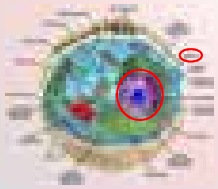
- If a standard is intended to be evidence, ***DO NOT*** use an offender card.
- Statewide database of ***evidence*** suspect profiles; not eligible for NDIS.
  - Must be ≥ 17 years old at the time of the crime.
  - Standards must be given voluntarily or collected by court order.

Not all evidence profiles are eligible to be searched in CODIS

Casework & Y-Screening Sections

Goal: Associate people, places, &/or objects by locating, identifying, & developing DNA profiles from biological material deposited on evidence.

- Deoxyribonucleic Acid (DNA)
  - → nuclear DNA in each cell's nucleus
  - → inherited 50/50 from mom & dad
  - → unique to each person, ***except identical twins***



testing can be narrowed to a single chromosome

Casework & Y-Screening Sections

Principal function of the Y-Screening section is evaluating sexual assault evidence for the presence of male DNA

- Each item in a Sexual Assault Kit (SAK) sampled & processed using high-throughput automation for male DNA detection
  - → *the most promising samples get profiled*
- Additional items (e.g. clothing, bedding) examined as needed
  - → *traditional serology (semen, blood) & swabbing (saliva, touch)*
- SAK should always be the 1st item submitted
  - → *if kit items make an association, other items aren't examined*

*****primary limitation*****
only useful for male / female assaults

- *one-sided inheritance*
  - → *entirely from dad*
  - → *same for all paternally-related males*
- *profiling vs. detection*
  - → *23 areas on chromosome vs.*
  - → *presence / absence*

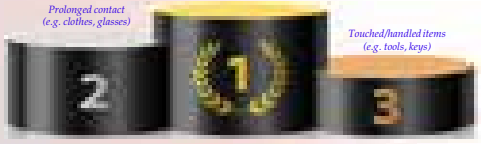
Evidence Collection & Preservation

- **GOOD EVIDENCE** *(lots of DNA)*
  - Blood
  - Semen
  - Saliva
  - Mucous
  - Hair ***roots***
- **BAD EVIDENCE** *(little to no usable DNA)*
  - Ammunition/magazines
  - Public use items
  - Wet/moldy items
  - Liquid urine
  - Feces

Body fluids
(blood, semen, saliva)

Prolonged contact (e.g. clothes, glasses)

Touched/handled items (e.g. tools, keys)

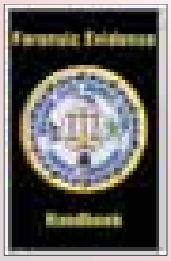


Evidence Collection & Preservation

- Safety first
  - Universal precautions
    - → *assume every item is biohazardous*
  - Personal Protective Equipment (PPE)
    - ***GLOVES***
    - Face mask/safety glasses
    - Disposable coveralls/shoe covers
- Keep it clean to avoid contamination
  - Limit access to the scene
  - Clean tools between collections
  - Change gloves frequently & between items

...anyone remember Amanda Knox??

Evidence Collection & Preservation



- Manual of general guidelines available at any MSHP lab & online
  - *AIR DRY EVERYTHING*
  - *PACKAGE IN BREATHABLE CONTAINERS*
  - *COLLECT REFERENCE STANDARDS*
  - *PACKAGE KNOWNS & UNKNOWNS SEPARATELY*
  - *PACKAGE SUSPECT & VICTIM EVIDENCE / KNOWNS SEPARATELY*

http://www.mshp.dps.Missouri.gov/MSHPWeb/Publications/Handbooks-Manuals/documents/SHP-145.pdf

...when in doubt, call us...

Evidence Collection & Preservation

- Your eyes are always your first detection method
  - Stains come in a variety of colors & textures
    - → vary angles & intensities of light sources
  - Blood can appear **RED** / **BROWN** / **BLACK** / **GREEN**
  - Mucous can appear **RED** / **BROWN** / **WHITE**
  - Semen can appear **WHITE** / **YELLOW** / **TAN**

- Luminol & Bluestar
  - ***Not*** specific for blood
    - Metals
    - Treated lumber
    - Animal fat
    - Bleach / cleaners
  - Examine surrounding areas for visible stains
    - → *more DNA*

Evidence Collection & Preservation

- Alternate light sources *(ALS)* / fluorescen
  - Location ***NOT*** identification
    - Semen
    - Saliva
    - Urine
    - Sweat
    - Vaginal fluids

- All that glitters…
  - Yogurt
  - Milk
  - Lotion
  - Glue
  - Bleach

Sexual Assault Evidence

- Sexual assault evidence
  - Body swabs are always best (SAK)
    - Consider type / extent / time elapsed since physical contact
      - → victim *and* suspect kits
  - Clothing
  - Towels
  - Condoms
  - Sex devices
  - Bedding

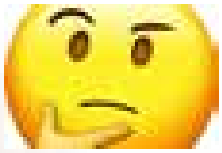
~ REMINDER ~

*our exams **cannot** tell you how or when a stain was deposited*

Considerations Before Collection

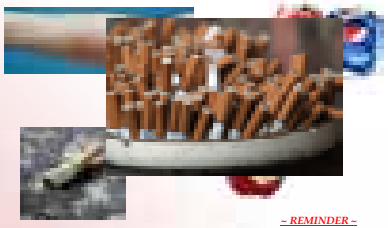
- Owner's DNA is expected to be found on his own items
  - Suspect's semen is allowed to be on his own bedding
  - Cannot test for vaginal secretions
  - *NOT* CODIS eligible
- Swabbing the suspect
  - Penile
  - Digital
- The more information the better
  - Locations
  - Injuries
  - Penetration
  - Ejaculation

…ask yourself, "what's the question I'm trying to answer?"



Saliva Evidence

- Body swabs are still best
  - External genitalia
  - Breast / neck lick
  - Bites / hickies
- Food, drink, tobacco
  - Bottles / cans / straws
  - Gum / food
  - Cigarette butts

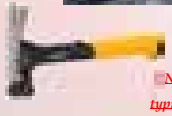


- *We do not detect saliva, merely collect from its likely location*

~ REMINDER ~
our exams cannot tell you how or when a stain was deposited

Touch DNA

- Skin cells left by touching item surfaces
  - More contact ➜ more DNA *(usually)*
  - *LATENT PRINTS OFTEN A BETTER OPTION*
- Success requires extensive contact
  - Tools & weapons
  - Eyeglasses
  - Ski masks



- Consider how an item may have been used in that given situation
  - ➜ *(not necessarily its intended use)*
- Collecting from the right area(s) makes the difference between enough DNA & none

DNA profiles from touch DNA are typically mixtures &/or incomplete

Sample Collection – General

- Sample collection options
  - Collect & submit entire items
  - Cut stain(s) from an item
  - Swab stain(s) / area(s) of interest
- Swab collection
  - Don't sacrifice other exams *(e.g. fingerprints)*
  - One drop of sterile water on a sterile swab
  - Press & rub the swab tip over the stain / area
  - Concentrate collection on the swab tip
  - Use fewest swabs necessary
  - No blank swabs or water controls needed





Do not scrape dried blood, swab

Do not swab semen from fabric, cut

Sample Collection – Firearms

- Usually best to submit entire item
- Swab stains separately
- Swab contact & textured areas
  - Trigger
  - Grip
  - Textured slide / hammer
  - Combine swabs *(limit two)*
- NO DNA EXAMS ON…
  - Shell casings
  - Ammunition
  - Magazines

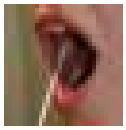
(unless there's body fluid staining)

Sample Collection – Reference Standards

- Buccal *(cheek)* swabs preferred
  - Blood *(purple-top tube)*
  - Hairs *(pulled; must have root)*
- *GLOVES*
- Two or more swabs
  - Rub inside cheek for 30 seconds
  - Separate right & left unnecessary
- Submit all relevant standards at the same time as the evidence
- ***Clearly label with individual's name***

…why we need standards…

CODIS entry requires profiles to be ***explicitly attributable*** *to perpetrator(s)*

If you have access to someone & they're willing to be swabbed…DO IT. Better to have it & not need it than need it & not have it

Sample Collection – Reference Standards

If a standard is intended to be evidence, DO NOT use an offender card.

If a standard is intended to be evidence, DO NOT use an offender card.

…if you absolutely, positively have "NOTHING" else…

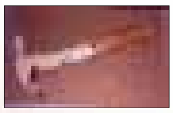
…clearly indicate on the card, in the case scenario, in the item record, & "ANYWHERE ELSE YOU CAN" the collection was voluntary &/or by warrant. "NOT" forced by statute…

- *OTHER UNACCEPTABLE STANDARDS*
  - Swabs from wounds
  - Clothing, drink containers, cigarette butts
  - Used personal items (*exceptions for body IDs*)
  - Don't dumpster dive or collect discarded trash

Evidence Packaging

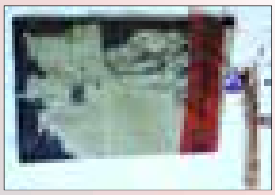
- Air dry, air dry, air dry
  - Wet stains transfer
  - Wet stains mold
  - Empty fluid containers
- Absorbent items can be frozen
  - Tampons
  - Condoms
- Safety
  - Boxes for breakables, tools, firearms
  - Sharps tube for syringes, knives
  - Minimized interior movement

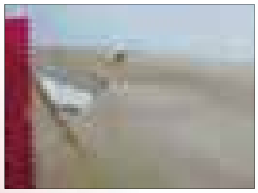
Breathable containers
Cardboard boxes
Paper bags
Envelopes



Evidence Packaging

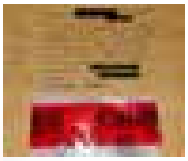
POOR PACKAGING & PRESERVATION DESTROYS EVIDENCE & COMPROMISES SAFETY





Evidence Packaging

- Clearly label with warnings, sources, descriptions
- Package items separately *(minimizes transfer)*
- One item per container whenever possible *(except SAK)*
- ***DO NOT OVERFILL CONTAINERS***
- ***SEAL SECURELY***



Evidence Submission – Case Acceptance Policy

- Cases we ***do not*** work…
  - Misdemeanors
  - No crime indicated
  - Shootings with only casings
  - Criminal paternity
- Property crime limitations
  - No "touch" items, just body fluids
  - Two items per submission
    - → *one item per container*
    - → *reference standards **do not** count*
- Possession case limitations
  - ***NOT ELIGIBLE FOR CODIS***
    - → *suspect reference standard **required***
    - → ***only** direct comparisons*
  - No "touch" items, just body fluids
  - Firearms, drugs

What do we want????

→ ***body fluids foreign to the scene***

blood from window they broke, can from soda they drank , cigarettes they smoked

no standards required, but victim eliminations always recommended

Evidence Submission

- ***INFORMATION IS EVERYTHING***
  - Aids informed processing decisions
  - Will not bias analysts' exams
  - CODIS ***requires*** specific information
    - → *NO INFORMATION = NO CODIS*

why?

…actual example…

Agency: "Sexual assault – usual exams"
Us: Tested for semen, negative results, done
report sent to agency
***Agency** (months later)*: "…suspect performed oral sex, no penile penetration"
Us: "…well that definitely matters…"

→ *swabbed underwear, FULL PROFILE*

- *Type of crime?*
  - → *NO CRIME = NO CODIS*
- *How is evidence thought associated to the crime / suspect(s)?*
  - → *NO ASSOCIATION = NO CODIS*
- *Was evidence seized directly from person's body / possession?*
  - → *EXPECTED DNA = NO CODIS*
  - → ***REFERENCE STANDARD REQUIRED***

Evidence Submission – [Web]LAR

- Summary if incident
  - → *IMPORTANT FOR CODIS ELIGIBILITY!!*
- List highest of multiple charges
  - → *it's how we prioritize cases*

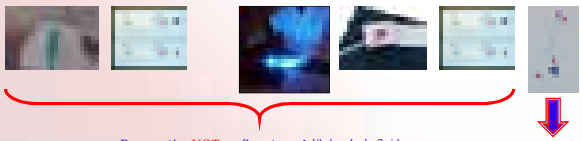
- Subject records
  - Suspect standard profiles of go into SDIS **if ≥ 17** at time of crime → ***DOB REQUIRED***
- Clear item description
  - → *not just "swab"*
- Subject association
  - → *known / suspected **owner***
- Seizure association
  - → *person / place from which item was **collected***

Evidence Examinations

- Location & detection

*Visual inspection **always** our first exam*

- Tests for blood & semen
  - Suspected blood → leucomalachite green, HemaTrace
  - Suspected semen → ALS, acid phosphatase, PSA, sperm search



Presumptive NOT confirmatory → *likely a body fluid*

CONFIRMATORY

portions of swabs & stains we sample & you submit are always preserved for possible future testing
(otherwise we seek "consent to consume")

DNA Profiling

- From cutting to profile
  - → ~8 hours *(if doing **ABSOLUTELY NOTHING ELSE**)*
  - Extraction *(bursts cells & isolates DNA)*
    - → ***differential extraction***
      - sex assault / semen samples
      - separates sperm from other cells
      - one sample becomes two *(sperm & non-sperm)*
  - Quantitation *(there has to be enough DNA)*
    - → ***touch samples often "insufficient"***
  - Amplification *(bursts cells & isolates DNA)*
    - → ***from one comes MANYMANYMANY***

- From profile to report
  - → *???????*
  - Data analysis & interpretation
  - Comparisons & conclusions
  - Statistical calculations
  - Report writing & peer review

DNA Profiling

- Data analysis & interpretation
  - → *profile quality varies*
    - single source
    - partial
    - mixture
    - junk

DNA Profiling

- Comparisons & conclusions
  - inclusions get stats when profile is detected in a foreign location *(e.g. victim blood on suspect clothes)*
    - → random match probability: estimated rarity of a single-source profile
      - *…you WILL see numbers beyond the population of the world…*
      - …a single-source profile is expected to be seen 1 time in 6.79 nonillion
      - *(6,790,000,000,000,000,000,000,000,000,000)* randomly selected, unrelated people…
    - → likelihood ratio: comparative probabilities of mixture profile scenarios
      - *…you MAY see numbers beyond the population of the world…*
      - …a mixture profile is 5.263 billion *(5,263,000,000)* times more likely to be a mixture of Jane Doe & John Doe than a mixture of Jane Doe & an unknown, unrelated person…
    - → no stats when profile is expected *(e.g. victim's DNA on her own underwear)*
  - exclusion eliminates an individual as a source / contributor
  - uninterpretable indicates data is too poor for comparisons

WORLD POPULATION

~ 7,900,000,000

Review

- CODIS (Databasing)
  - Goal: Association of unknown forensic profiles to known individuals
  - Collection, processing, storage of samples collected pursuant to statute RSMo 650.050
  - Databasing purposes only, *NOT EVIDENCE*
- *Single, central location – Jefferson City*

- Casework & Y-Screening
  - Goal: Association of people, places, &/or objects by developing DNA profiles from biological material
  - Examine evidence to locate & identify potential sources of DNA
  - Body fluids are best, touch DNA samples often not useful
- *Three locations – Jefferson City, Springfield, Cape Girardeau*

Review

- Evidence collection
  - Determine your question to know what evidence might provide an answer
    - Safety first
    - Keep clean
    - Limit access
    - Visualize & detect
    - Collect, cut, or swab
  - Collect any & all reference standards possible
    - *DO NOT USE OFFENDER CARDS!!!*
- Evidence submission
  - *INFORMATION INFORMATION INFORMATION INFORMATION*
    - Clear, complete, correct labelling
    - Clear, complete, correct narrative
    - Clear, complete, correct subject records
    - Clear, complete, correct item records

…when in doubt, call us…

Review

- Case acceptance policy
  - Not worked
    - Misdemeanors
    - Non-crime
    - Casing-only shootings
    - Paternity
  - Property crimes
    - Body fluids only
    - Two item limit *(not including standards)*
  - Possessions
    - *BODY FLUIDS ONLY*
    - *NOT ELIGIBLE FOR CODIS*
    - *REFERENCE STANDARDS REQUIRED*
- CODIS eligibility
  - Highly standardized requirements
    - Crime committed
    - Profile from evidence *of the crime*
    - Directly associated to perpetrator
    - Where / how collected
    - Collected from person / possession
    - Elimination standards

…when in doubt, call us…

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