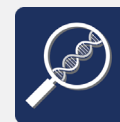


The Application of Touch DNA to Cold Case Investigations



BJA
Bureau of Justice Assistance
U.S. Department of Justice

IRTI
INTERNATIONAL



OTHER VIOLENT
COLD CASE
CRIMES

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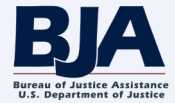
RTI International is an independent, nonprofit research institute dedicated to improving the human condition. RTI International combines scientific rigor and technical expertise in social and laboratory sciences, engineering, and international development to deliver solutions to the critical needs of clients worldwide.

The National Sexual Assault Kit Initiative Training and Technical Assistance (SAKI TTA) program is led by RTI International and in partnership with a team of subject matter experts from various organizations. SAKI TTA offers expertise and assistance to jurisdictions as they establish victim-centered, evidence-based, sustainable practices related to the collection and processing of sexual assault forensic evidence, the investigation and prosecution of sexual assault cases (including cold case sexual assaults) and the support of survivors of sexual assault through practices that promote healing.

SAKI TTA's Other Violent Cold Case Crimes (OVCCC) focus area aims to support SAKI sites investigating homicides, attempted homicides, kidnappings, and missing and unidentified persons associated with suspicious circumstances. OVCCC seeks to help agencies expand their efforts to combat additional violent cold case crimes and identify serial offenders through the application of advanced forensic and investigative techniques.

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Introduction

On behalf of the Bureau of Justice Assistance (BJA), the National Sexual Assault Kit Initiative Training and Technical Assistance (SAKI TTA) Other Violent Cold Case Crimes (OVCCC) Team wants to thank you for your willingness to grow your knowledge about touch DNA analysis and its applications to cold case investigations.

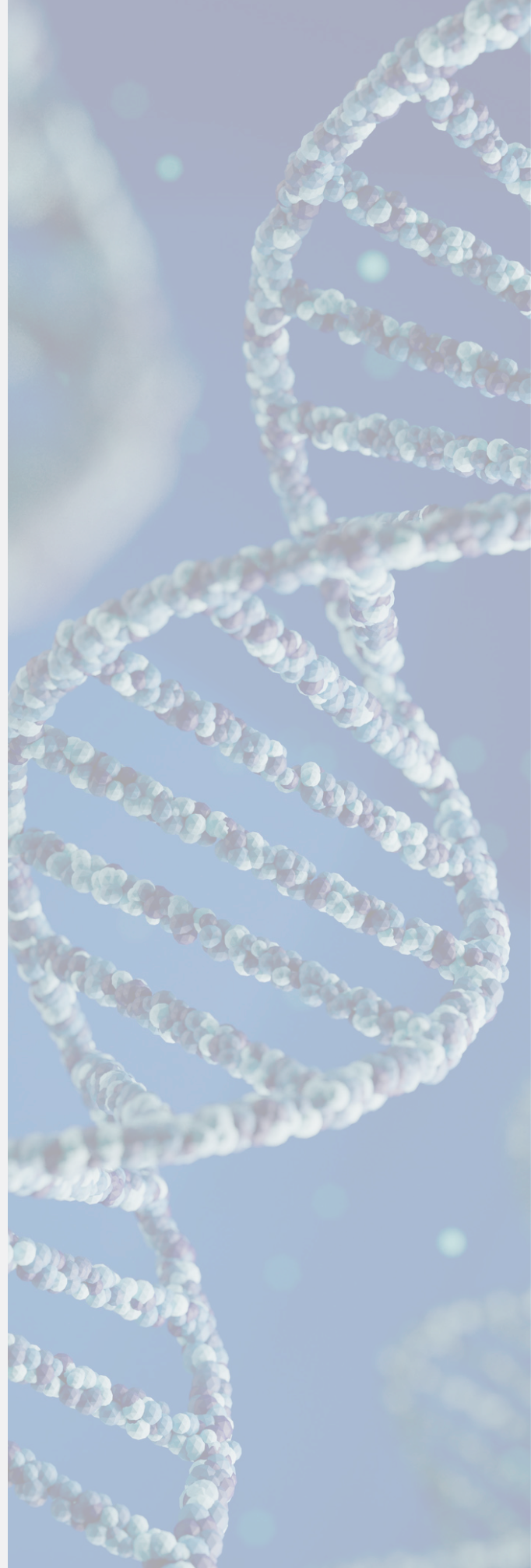
This workbook aims to provide law enforcement investigators and other criminal justice partners involved in a cold case multidisciplinary team with a basic understanding of how touch DNA analysis can aid in attaining cold case resolutions. This workbook aims to equip cold case investigators with a foundational knowledge of touch DNA that will aid making informed decisions regarding evidence selection and submission for touch DNA analysis.

This workbook contains a comprehensive glossary of relevant terms and knowledge check activities, and provides readers with suggested questions to guide conversations with forensic laboratory personnel when evaluating evidence to submit for touch DNA analysis. Readers will also find various applicable forms and documents that may be adapted by their respective agencies within the appendices for implementation and use.

This workbook complements the online interactive training module “The Application of Touch DNA to Cold Case Investigations,” which can be found on the [SAKI TTA Virtual Academy](#). To access this training module, a SAKI TTA account is required. These accounts are free to make. If you do not have a SAKI TTA account, please fill out this [online form](#) to create one. Use your account log-in information when redirected by the link above to access the training module. Both this workbook and the training module were developed by Ashley Rodriguez, Program Manager, and Mikalaa Martin, Forensic Scientist, at RTI International in consultation with other law enforcement and DNA subject matter experts.

Again, thank you for your interest in the application of touch DNA to cold case investigations. We hope this workbook better your understanding of touch DNA topics!

—SAKI TTA OVCCC Team



SECTION 1

Principles of Touch DNA

Learning Objectives

- ◆ Develop an understanding of the basics of touch DNA
- ◆ Understand how touch DNA can assist law enforcement investigators in cold case investigations
- ◆ Identify the various ways DNA can be transferred
- ◆ Understand how transferred DNA affects evidence selection

What is Touch DNA?

According to **Locard's exchange principle**, every contact leaves a trace. In practice, when a perpetrator touches an object, surface, or individual during the commission of a crime, DNA from their skin cells may be left behind. This is referred to as **touch (or trace) DNA**, which may be used to link that individual to the crime scene, objects used, and other individuals involved.

Touch DNA (or Trace DNA): "The DNA that is left behind from skin cells when a person touches or comes into contact with an item."¹

CASE STUDY

Touch DNA Analysis Leads to Life Without Parole^{2,3}

On July 11, 2009, Julianna Grna, 85, and her son Alan Grna, 43, were beaten to death inside their Akron, Ohio home. Numerous items were also stolen from the residence, including the victim's vehicle, cell phone, and various pieces of jewelry. While processing the crime scene, an investigator surmised the perpetrator may have washed their hands in an upstairs bathroom and dried them with toilet paper. Because of this inference, it was theorized that the perpetrator likely touched the inside of the toilet paper roll, leading to its submission to the laboratory for touch DNA analysis. After processing the inside of the toilet paper roll, an unknown profile was developed. Investigation revealed Johnnie Cook, 32, as a person of interest based on the use of the victim's cell phone. Cook had also pawned the stolen jewelry shortly after the murder and, after a hit-and-run accident, he was found to be using the victim's vehicle. The unknown profile developed from the inside of the toilet paper roll was found to be consistent with Cook, placing his DNA at the scene of the crime. Cook was charged with four counts of aggravated murder with a death specification, two counts of aggravated burglary, theft, grand theft, and theft from the elderly. He was sentenced to life without parole.

Touch DNA for Cold Case Investigations

While touch DNA collection and processing is now common practice for most evidence submitted to forensic laboratories, the advent of this technique can also be applied to **cold case investigations** where evidence was previously processed but yielded negative results. Applying the principles and techniques of touch DNA to **cold case evidence** may shed new light on the case and provide valuable investigative information for law enforcement to aid case resolution.

Variables Impacting the Ability to Recover Touch DNA

Touch DNA is invisible to the naked eye and is typically deposited in smaller amounts than the DNA found in biological fluids (e.g., blood, saliva, and semen). The success of touch DNA depends on many variables, including the type of material tested and the laboratory **sampling technique** used during evidence processing.*

When considering touch DNA analysis, it is best practice for law enforcement investigators to consult with a **multidisciplinary team (MDT)**

* Reference Section 2, Variables Affecting the Transfer and Recover of Touch DNA, and Section 3, DNA Sampling Techniques, for more information on these topics.

that includes laboratory personnel to develop a strategy focused on prioritizing samples that will increase the chances of obtaining a **probative** DNA profile.

Multidisciplinary team (MDT): A working group of allied criminal justice professionals that meets regularly to discuss factors related to unresolved cold cases. These factors may be case-specific, such as the review of evidentiary items to determine suitability for laboratory submission, or broader factors, such as ensuring cold case investigation protocols are systematic and are in line with a **trauma-informed** and **victim-centered** approach.

Direct vs. Indirect Transfers

Touch DNA can be transferred by both **direct** and **indirect** means:

- ◆ **Direct Transfer** occurs when an individual's DNA is transferred to an object or surface through touching it with their bare hands, or by wearing an item that comes into contact with their skin. A direct transfer event may also occur between two individuals.
- ◆ **Indirect Transfer** occurs when DNA from an individual ends up on an object, surface, or individual they did not directly touch or make contact with. Indirect transfer can take the form of:
 - **secondary transfer** (between three object(s), surface(s), or individual(s)), or
 - **tertiary transfer** (between four object(s), surface(s), or individual(s)).

DNA can be directly or indirectly transferred to an item **before**, **during**, or **after** the crime.

- ◆ **Background DNA:** DNA that already existed on an object, surface, or individual **before the crime**.
- ◆ **Touch Deposit:** The transfer of touch DNA to an object, surface, or individual **during the crime**.
- ◆ **Contamination:** The transfer of DNA to an object, surface, or individual **after the crime** occurred, which could be from non-involved individuals present at the scene, allied criminal justice professionals that handled evidentiary items **during or after collection**, or by means of multiple collected evidentiary items packaged and stored together.

Example of Indirect Transfer

To commit a crime, **Person A** wears work gloves typically worn by **Person B**. Before exiting the crime scene, **Person A** removes the gloves and uses their bare hands to drink a bottle of water, which is left behind at the scene. The bottle of water is swabbed for DNA and results in a mixed profile that cannot exclude **Person A** or **Person B**. Although **Person B** was never at the crime scene, their DNA was transferred to the water bottle after **Person A** wore their gloves.

Activity

Principles of Touch DNA

Consider a scenario in which **Person A** purchased a handbag from a store. Upon leaving the store, **Person B** attempted to steal the handbag. After this occurred, **Person A** called law enforcement to report the crime and have the handbag swabbed for touch DNA for investigative purposes.

Answer the following questions based on the above scenario to apply what you have learned.

Reference Appendix G for correct answer choices and reasonings.

1

Person A purchased a new handbag at a store. The **sales associate** handled the handbag during the transaction. DNA deposited on an object before a crime is committed is referred to as _____.

- A. Contamination
- B. Background DNA
- C. Touch Deposit

2

Upon leaving the store, **Person B** attempted to mug **Person A**, grabbing the straps of the handbag in the process. DNA deposited on an object during the commission of a crime is referred to as _____.

- A. Contamination
- B. Background DNA
- C. Touch Deposit

3

When law enforcement arrived on scene to begin the preliminary investigation, **Detective A** handled the bag without gloves. DNA deposited on an object after a crime occurred is referred to as _____.

- A. Contamination
- B. Background DNA
- C. Touch Deposit

4

Which of the following individuals presented in this scenario may be present in a resulting DNA profile when processing the handbag for touch DNA?

- | | |
|--------------------|---------------------|
| A. Person A | E. A and C |
| B. Sales Associate | F. B and D |
| C. Person B | G. All of the above |
| D. Detective A | |

Key Takeaways

Principles of Touch DNA

Touch DNA can provide potential leads for cold case investigations. When reviewing evidence for resubmission, law enforcement investigators should work to identify objects and surfaces that the perpetrator may have handled during the crime as potential candidates for this type of analysis.

Touch DNA can be transferred directly or indirectly before, during, or after a crime. When determining which evidence to submit, law enforcement investigators should discuss these types of transfer with their multidisciplinary team (MDT) to decrease the likelihood of obtaining nonprobative profiles.

Notes

Principles of Touch DNA

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Variables Affecting the Transfer and Recovery of Touch DNA

Learning Objectives

- ♦ Anticipate variables that may increase or decrease the ability to obtain a touch DNA profile from evidentiary items
- ♦ Identify types of evidentiary items that present a higher likelihood of yielding usable profiles from touch DNA analysis

CASE STUDY

Touch DNA Implicated Homeless Man in Murder^{4,5}

In December 2012, Lukis Anderson was charged with the murder of a Silicon Valley multimillionaire, Raveesh Kumra due to the identification of Anderson's DNA on Kumra's fingernails. Anderson was not able to recall the night in question because of a severe state of intoxication and was subsequently placed in jail awaiting trial. After 5 months in jail, Anderson was released when it was determined that he had spent the entire night in question in the hospital being treated for his intoxication. It was discovered during the investigation that Anderson's DNA was found on Raveesh's fingernails through an indirect DNA transfer contamination event, as the paramedics who had treated Anderson for intoxication responded to Kumra's murder scene 3 hours later. When handling Kumra, the paramedics had transferred the DNA on their hands, which included Anderson's DNA.

It can be difficult to predict the successfulness of touch DNA analysis. Listed below are seven common variables that can affect the transfer of touch DNA to an item, as well as the laboratory's ability to recover enough DNA to produce a usable profile. Being aware of these variables and their potential limiting factors can help determine which evidentiary items may be best suited for touch DNA analysis.

1. Individual Characteristics (e.g., shedder status and skin conditions)

- ♦ **Shedder status** is a term used to discuss an individual's ability to deposit touch DNA on a surface or object through direct contact.⁶
 - A '**shedder**' refers to an individual who tends to leave behind DNA more naturally than a '**non-shedder**'.
- ♦ Certain medical conditions and behavioral trends can make an individual more likely to deposit touch DNA and thus be classified as a shedder.

Factors That May Increase Touch DNA Deposits

Medical Conditions	Behavioral Trends
<ul style="list-style-type: none"> ♦ Gland disorders (hyperhidrosis) ♦ Skin diseases (psoriasis) ♦ Skin irritation (dermatitis) 	<ul style="list-style-type: none"> ♦ Personal hygiene (under-washing hands) ♦ Skin picking (dermatillomania)

2. Manner, Duration, and Area of Contact

- ♦ **Manner** relates to the way an individual handled an item or surface, **duration** relates to how long an individual handled an item or surface, and **area of contact** relates to the surface area of the object that an individual touched.

3. Surface Type (e.g., material and texture of item being tested)

- ♦ Surface types are often referred to as **porous**, **non-porous**, or **semi-porous**. These different **substrate** types can affect the ability to retain touch DNA evidence for future testing.

- ◆ Certain materials, such as those that are **porous** in nature, can promote easier transfer or recovery, which, in turn, can yield higher amounts of DNA and promote more-suitable DNA profiles.

Substrate Types

- ◆ **Porous:** A substrate that **contains minute spaces** that retain deposited touch DNA.
Examples: clothing, carpets, bedding
- ◆ **Non-porous:** A substrate that does **not contain minute spaces**.
Examples: firearms, tools, door handles
- ◆ **Semi-porous:** A substrate that demonstrates qualities of being **both porous and non-porous**.
Examples: magazines, wood, concrete

4. Background DNA and Contamination

- ◆ **Background DNA** and **contamination** can affect the successful recovery of touch DNA.*
- ◆ Both of these variables can result in DNA **mixtures** that include non-involved, case-irrelevant individuals, which may raise questions regarding how **probative** the resulting profiles are.

- ◆ **Background DNA:** DNA that already existed on the item before the crime.
- ◆ **Contamination:** The transfer of DNA to an item after the crime occurred, which could be from non-involved individuals present at the scene, allied criminal justice professionals that handled evidentiary items during or after collection, or by means of multiple collected evidentiary items packaged and stored together.

5. Environmental Factors and the Persistence of DNA

- ◆ DNA **persistence** can be affected by the various environmental conditions in which the item was found before collection or stored in after collection.

- ◆ Nonideal temperature, humidity, and other environmental factors can damage and **degrade** DNA, resulting in decreased chances of obtaining a usable DNA profile.

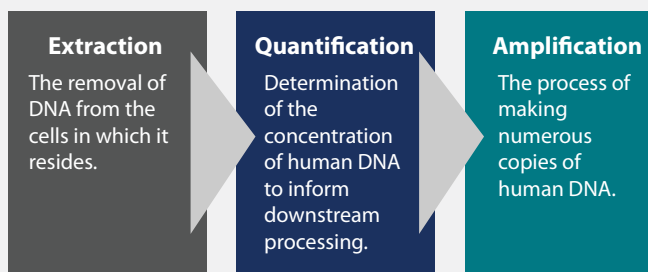
6. Sampling Techniques

- ◆ **Sampling techniques** are the methods a laboratory uses in an attempt to recover touch DNA from an item or surface.
- ◆ Various **sampling techniques** can be employed to obtain a potentially higher yield of DNA, depending on the surface type and other variable considerations, such as **area of contact**.**

Environmental Factors Affecting DNA Persistence	
Ideal	Nonideal
<ul style="list-style-type: none"> ◆ Low humidity (< 60%)⁷ ◆ Little to no light ◆ Storage at 60-75 °F in a temperature-controlled environment⁸ 	<ul style="list-style-type: none"> ◆ High humidity (> 60% at room temperature) ◆ Direct sunlight ◆ Extreme heat ◆ Ultraviolet (UV) rays

7. Laboratory Procedures and Workflows

- ◆ Multiple steps are involved in DNA processing workflows within forensic laboratories, including **extraction, quantification, and amplification**.
- ◆ A portion of the DNA sample from an evidence item may be lost during any, or all, steps involved in DNA processing. For example, DNA can become bound to equipment used during the **extraction** phase and, thus, potentially negatively impact the following phases of **quantification** and **amplification**.



* Reference Section 1, Principles of Touch DNA, for more information on these topics.

** Reference Section 3, DNA Sampling Techniques, for more information on this topic.

Activity

Evidence Submission Considerations

Multiple evidentiary items relating to a specific case may have been collected and stored. Keeping the variable considerations presented in this section in mind can help with determining which item(s) may be best suited for touch DNA processing.

Can you identify what evidentiary item would be best to submit to the laboratory for each scenario?

Reference Appendix G for correct answer choices and reasonings.

1

Option 1: A hat worn by the perpetrator of a crime who is known to have psoriasis based off of previous medical records.

VS

Option 2: A pair of gloves worn by the perpetrator of a crime who is known to be meticulously clean and frequently partake in handwashing because of struggling from obsessive compulsive disorder (OCD).

2

Option 1: A metal rod used in a crime that the perpetrator, who was wearing sterile gloves, had heavily handled for a long time.

VS

Option 2: A metal rod used in a crime that the ungloved perpetrator carried during a portion of the crime.

3

Option 1: A small portion of concrete that the perpetrator heavily handled and used to break into the victim's window before the crime.

VS

Option 2: A large piece of a shirt the perpetrator was wearing and tore when attempting to flee from the scene of a crime through the victim's window.

4

Option 1: A T-shirt worn by the perpetrator of a crime that has been stored in a non-air-conditioned warehouse without humidity monitoring.

VS

Option 2: A T-shirt worn by the perpetrator of a crime that has been stored in a non-windowed warehouse that is constantly kept at room temperature.

Call to Action

Discuss these topics with your **multidisciplinary team (MDT)**.

Has the laboratory identified or encountered any other variables that negatively impact the successfulness of touch DNA processing that law enforcement should consider?

Does the laboratory have any recommendations regarding evidence or surface types that are more likely to generate a DNA profile over others?

What should law enforcement take into consideration when storing and handling touch DNA evidence to mitigate potential **contamination** and loss of evidence?

Case-specific: What elements in this case may prohibit or promote the recovery of touch DNA?

SECTION 3

DNA Sampling Techniques

Learning Objectives

- ◆ Understand various laboratory sampling techniques and the types of evidence they are best suited for
- ◆ Discuss sampling techniques used for previously tested evidence and determine if a newer, alternative technique may provide better results

Touch DNA **sampling techniques** (i.e., techniques used by DNA analysts to attempt to collect DNA from an evidentiary item) have been used in forensic laboratories for more than two decades. These techniques have allowed for the successful generation of DNA profiles from evidentiary items that were previously tested but yielded unusable results and from those that are considered challenging samples, such as bullet casings, clothing, portions of cement, ligatures, and water-soaked items. When deciding on a **sampling technique**, law enforcement investigators should discuss the surface type of the item, the environment the item was found in, and other touch DNA variables with their **multidisciplinary team (MDT)** to ensure an appropriate technique is used in an attempt to develop a DNA profile from previously tested or untested evidence.*

CASE STUDY

The Use of the Scraping DNA Sampling Technique to Resolve a Cold Case¹

In the mid-1990s, a young female was sexually assaulted on her way home from school. The female survived the assault and informed law enforcement investigators that the perpetrator had torn the neckband of her shirt, knotted it, and used it to bind and gag her. The victim's shorts, shirt, and the torn piece of shirt used as a gag were submitted for forensic DNA testing; however, no semen or male DNA was detected in the samples. During the investigation, law enforcement investigators identified a possible suspect but were unable to locate physical evidence that could be used to link him to the crime. In 2008, a renewed investigation was launched, and the evidence was re-submitted for touch DNA analysis. The torn neckband used to bind and gag the victim remained in its original knotted state, and DNA analysts used the scraping DNA sampling technique to obtain a sample from areas the perpetrator would have likely touched to develop the knot. This sample was submitted for touch DNA analysis and yielded a DNA profile presenting a mixture of two individuals. The victim and suspect could not be excluded as contributors to the mixture DNA profile produced from the analysis. These results linked the suspect to the crime, and he was subsequently charged with first-degree rape and sexual assault and sentenced to serve two consecutive life sentences.

Wearer vs. Handler DNA

Law enforcement investigators in collaboration with their MDT should identify whether the item will be tested for **wearer** or **handler** DNA before choosing a sampling technique.

- ◆ **Wearer:** The habitual user of an item.
- ◆ **Handler:** The individual using or touching the item during the crime, associated with one-time use or contact.

The scope of the investigation and relevant case details will aid in determining whether an item will be tested for **wearer** or **handler** DNA and in deciding which sampling technique may be best suited for the evidence. Consider an aggravated assault case of an unidentified victim and unknown perpetrator. If trying to identify the perpetrator, the laboratory would sample the **outside** of the clothing worn by the victim for **handler** DNA, as the outside of the clothing would more than likely have been handled

* Reference Section 2, Variables Affecting Touch DNA, for more information on these topics.

by the perpetrator. If trying to identify the unidentified victim, the laboratory would sample the **inside** of the clothing worn by the victim for **wearer** DNA, as the inside of the clothing rested against the victim and would be less likely to have been handled by the perpetrator. As demonstrated through this scenario, the determination to test for **wearer** or **handler** DNA will depend on the case circumstances, available information, and investigative interests.

Touch DNA From Degraded Clothing Best Practice

When trying to obtain a **handler** (e.g., suspect) DNA profile from an article of clothing worn by the victim, the item should first be tested for **wearer** (e.g., victim) DNA. If wearer DNA cannot be obtained, it is likely that the sample is too **degraded**, and will yield negative results if subjected to further testing for handler DNA.

Common Sampling Techniques

1. The most-routine techniques for sampling DNA have historically been a swab or cutting.
 - ♦ A **swab** is often optimal for collection from **non-porous** surfaces (e.g., glass, plastic). A cotton swab's absorbing properties aid in collection when it is moistened with distilled water and applied to an evidentiary item with pressure and friction to recover possible DNA. In most instances, a moist swab followed by a dry swab can enhance DNA collection. This practice is known as the **double swabbing** technique.
 - ♦ A **cutting** from an item may be more suitable for DNA collection than a swab for **porous** surfaces (e.g., fabric, sponge). A cutting can be useful in obtaining DNA from deeper into a porous surface.
2. Tape-lifts and scrapings have become established touch DNA sampling techniques because they allow for collection from large surface areas, in some instances replacing swabs and cuttings.
 - ♦ For **tape-lifts**, the adhesive side of tape is used for the collection of **cellular material**. An adhesive substance may be better at collecting DNA from the surface of an item

rather than deeper down into the material. **Tape-lifts** have been successfully applied for use on **wearer** and **handler** items from both **non-porous** and **porous** surfaces. Of note, tape-lifting is an optimal sampling technique for delicate fabrics, which are common in cold cases as a result of age-related deterioration.

- ♦ A **scraping** method is best applied on porous surfaces such as fabric. Using a sharp metal blade such as a scalpel, a large area of a fabric's top layer can be collected, which usually provides a mix of cellular material and fabric threads.
3. Alternative techniques such as the use of an M-Vac device or a soaking technique may prove beneficial when traditional techniques fall short.
 - ♦ The **M-Vac** device was developed to provide an alternative to swabbing and cutting of touch DNA items. This device uses a wet-vacuum approach for collection of **cellular material**, thus allowing sampling of a large area. The wet vacuum approach can pull material from deep inside a fabric and can also be used on challenging surfaces (e.g., rocks, aged clothing). The use of a wet-vacuum approach precludes evidence from additional testing, which may negatively impact a case if additional testing is required (e.g., M-Vac approach led to negative results) or requested (e.g., if the case goes to trial and the defense party requests independent testing of the item).⁹
 - ♦ **Soaking** small items such as ammunition and jewelry in a solution typically used in DNA **extraction** may enhance DNA recovery. This method causes any cellular material on the item to break open and release DNA into the **soaking** liquid.

Before applying a new, alternative sampling technique to forensic casework samples, the laboratory must go through a **validation** process to establish assurance that the technique will consistently perform and produce reliable results that meet established, predetermined requirements. Law enforcement investigators are encouraged to discuss, with their laboratory representative, which **sampling techniques** are currently validated and utilized for casework samples.

Common items collected for touch DNA and sampling techniques to consider.*	
Common Touch DNA Items	Laboratory Sampling Technique Considerations
Baseball cap (wearer)	Cutting or scraping
Cartridges or casings (handler)	Swab or soaking
Clothing (handler)	Tape-lift or scraping
Clothing (wearer)	Tape-lift or scraping
Condom wrapper (handler)	Swab or cutting
Eyeglasses (wearer)	Swab
Fabric gloves (wearer)	Cutting, scraping, or tape-lift
Fingernail clippings (suspect or victim)	Swab or soaking
Interior of underwear crotch (wearer)	Cutting or scraping
Nitrile gloves (wearer)	Cutting (fingertips); swab (base)
Pantyhose (wearer)	Tape-lift
Plastic bottle (handler)	Swab (non-mouth area)
Ransom note (handler)	Swab or cutting
Rock (handler)	Swab or M-Vac
Smooth surface ligature (handler)	Swab or tape-lift
Steering wheel (handler)	Swab
Weapon handles (handler)	Swab

* Note: This table is for consideration purposes only and is not exhaustive. The determination to test for **wearer** or **handler** DNA and what sampling technique is utilized will fluctuate as it depends upon the nature and circumstances surrounding each case. Law enforcement investigators should consult with their laboratory representatives when determining the most-appropriate technique to use as there is no standard best practice because of the number of variables affecting touch DNA transfer and recovery. Therefore, laboratories should consider utilizing **validated** methods before unvalidated alternative approaches.

Activity

Wearer vs. Handler DNA Concepts

Before determining the best sampling technique to be utilized on an evidentiary item, it is important to identify whether the item is being tested for **wearer** or **handler** DNA.

Can you identify which individuals would be considered a wearer or handler and which items should be tested for wearer or handler DNA?

Reference Appendix G for correct answer choices and reasonings.

Fill in the blanks with the most-appropriate answer choice.

1

The homicide **victim** was found bound and gagged. Based on the investigation, **Detective A** believes the **suspect** used the victim's shoelaces as bindings. The shoelaces were sent for DNA testing. In this case the **victim** is the _____ and the **suspect** is the _____.

- A. Wearer; Handler
- B. Handler; Wearer

2

Cartridge casings, handles of weapons, and condom wrappers are common touch DNA items that are submitted to the laboratory to test for _____ DNA.

- A. Wearer
- B. Handler

3

It is believed the **suspect** and **victim** had a physical altercation, during which the **victim** pulled off the **suspect's** mask. The mask was recovered on the scene and sent for DNA testing. In this case, the **victim** is the _____ and the **suspect** is the _____.

- A. Wearer; Handler
- B. Handler; Wearer

4

Clothing, eyeglasses, and gloves of various materials are common touch DNA items that are submitted to the laboratory to test for _____ DNA.

- A. Wearer
- B. Handler

Call to Action

Discuss these topics with your **multidisciplinary team (MDT)**.

Does the laboratory offer all of the **sampling techniques** discussed above? Does the laboratory offer any other additional techniques that were not discussed?

Does the laboratory offer a training or open-house event to law enforcement and other criminal justice professionals to inform about the laboratory's workflows and testing options available for cold case evidence?

Case-specific: We have partial DNA profiles generated from touch DNA items. Are there any other **sampling techniques** that could be attempted that may produce more usable results?

Case-specific: A previously tested piece of cold case evidence yielded in a negative result. Would this item be a contender for retesting utilizing newly **validated** alternative methods offered by the laboratory?

Key Takeaways

DNA Sampling Techniques

Various sampling techniques can be utilized for a large range of evidence items.

Starting a conversation with laboratory personnel can help determine which items would be best suited for testing and would be more likely to provide usable DNA results.

Law enforcement investigators are encouraged to work with their laboratory representatives to evaluate previously tested evidence. The laboratory representative can provide guidance on whether another technique would provide better results.

Notes

DNA Sampling Techniques

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SECTION 4

Mixtures

Learning Objectives

- ◆ Develop a basic understanding of mixtures and how they affect testing results and interpretation of DNA profiles
- ◆ Understand the importance of obtaining control, reference, and elimination samples to ensure resulting DNA profiles are relevant to law enforcement’s investigation and can protect against false investigative leads

CASE STUDY

Mixture Interpretation of Cold Case Evidence Exonerates Individual Sentenced to Life^{10,11}

Mark Carver was convicted for the 2008 murder of University of North Carolina at Charlotte student Irina Yarmolenko and sentenced to life in prison. The victim’s body was found on an embankment of the Catawba River 100 yards from the spot where Carver and his cousin, Neal Cassada, had been fishing. Although there was no clear evidence of guilt, both men were charged with Yarmolenko’s murder. Various items were collected and sampled for touch DNA, with only Yarmolenko’s vehicle producing partial profiles contributed from Carver and Cassada. In 2010, retesting of three ligatures found on the victim’s body were compared to reference samples willingly provided by Carver and Cassada. The first ligature, a ribbon, only presented DNA belonging to the victim. The second ligature, a drawstring, presented a mixture of a major profile belonging to the victim and a minor profile which was “too weak to reliably interpret.” The third ligature, a bungee cord, presented a mixture of a major profile belonging to the victim and an unknown minor profile that excluded both Carver and Cassada. Because of various flaws in collection and processing of the evidence, as well as a lack of incriminating evidence, Carver was released from prison on June 11, 2019, while Cassada had passed away from natural causes awaiting trial.

What Are Mixtures?

A **mixture** can be defined as a “biological sample that originated from two or more donors and is determined after a DNA profile is generated.”¹² DNA **mixtures** are common occurrences in touch DNA evidence and present themselves after being analyzed by the laboratory. **Background DNA, contamination, and touch deposits** are common occurrences that can lead to samples that contain DNA profiles from multiple individuals (e.g., victim, suspect, criminal justice professionals, uninvolved individuals).*

Mixtures include **major contributor(s)** and **minor contributor(s)** components that can be distinguished by the DNA analyst from the resulting DNA data.

- ◆ **Major Contributor:** The individual(s) contributing more DNA to a mixture, in which the associated profile would be considered a major profile.
- ◆ **Minor Contributor:** The individual(s) contributing less DNA to a mixture, in which the associated profile would be considered a minor profile.

Although the presence of an individual’s DNA on a touch sample likely means they handled the item at some point either prior, during, or after the crime, in rare circumstances, the direct **handler** of the item is not present in the resulting profile. Instead, **non-self DNA** may be present through the means of **indirect transfer**. For example, consider a situation where the perpetrator of a kidnapping rode the

* Reference Section 1, Principles of Touch DNA, for more information on these topics.

subway prior to the kidnapping and interacted with a pole grip before handling a firearm during the crime. While handling the subway pole grip, the DNA of an uninvolved individual was deposited on the perpetrator's hand. When the perpetrator handled the firearm during the crime, they deposited **non-self DNA** (the uninvolved individual's DNA) onto the weapon. Upon analysis of the firearm, the uninvolved individual's DNA was identified; however, the perpetrator's DNA was not.

Control and Reference Samples

When a **mixture** is obtained, laboratory personnel must separate the profiles and interpret the results to determine whether they are relevant to the investigation. In the past decade, **probabilistic genotyping software (PGS)** has helped overcome this obstacle by providing a more-objective approach to DNA profile **interpretation**. PGS allows for **mixture interpretation** through the application of various statistical methods in place of previously employed manual approaches. Despite the improvement made by adopting a more-objective way of profile interpretation, the software does not provide answers regarding the relevance of profiles within the **mixture** or answer questions pertaining to how or when the DNA was deposited. Having **control samples** and **reference samples** from the scene can help laboratory personnel interpret the results to determine which profiles may be **probative**.

- ♦ **Control sample (blank sample):** "A sample of a known source that was presumably uncontaminated during the commission of a crime."¹³
- ♦ **Reference sample (standard sample):** A sample that can be compared against a known profile in a forensic casework sample that shows association between the crime scene, perpetrator, or victim.¹³

Example of a Control Sample

- ♦ A bloodstained piece of carpet was sampled for touch DNA and presented a **mixture** containing a **major profile** belonging to the perpetrator and an unknown **minor profile**. A **control sample** consisting of a portion of a non-stained piece of the same carpet was submitted alongside of the forensic casework sample. Upon testing the **control sample**, it yielded a profile which, when compared to the questioned sample, matched the **minor profile**. Laboratory personnel can now rationalize the presence of this **minor profile**.

Example of Reference Samples

- ♦ A towel utilized during an aggravated assault at the victim's home was sampled for touch DNA and presented a **mixture** containing a **major profile** and two **minor profiles**. Three **reference samples** were submitted alongside the forensic casework sample: one from the victim, one from the victim's roommate, and one from the presumed perpetrator. Upon comparing these **reference samples** to the forensic casework sample, the laboratory was able to determine that the **major profile** belonged to the victim, one of the **minor profiles** belonged to the presumed perpetrator, and the other **minor profile** belonged to the victim's roommate, likely because of **background DNA**.

Elimination Samples and Elimination Databases

In addition to the DNA of individuals involved with the crime, or present because of **background DNA** events, it is possible to find **mixtures** containing DNA from law enforcement, laboratory staff, or other criminal justice personnel as a result of a **contamination** event. **Elimination samples** can help identify if resulting profiles are from a staff member that collected, handled, or processed an item of evidence.¹³ It is best practice for agencies to have **elimination sample** profiles stored in a searchable database that DNA analysts can use to perform contamination checks to ensure profiles within the **mixture** are relevant to the investigation.

It is recommended that forensic DNA laboratories maintain elimination databases with DNA samples from laboratory personnel, law enforcement officers, crime scene investigators, cleaning staff, first responders, and any other individuals who may come in contact with items of evidence at any stage from collection at the scene through final disposition.^{15*} Lack of appropriate **elimination databases** by allied professionals can have negative impacts during profile **interpretation** such as a consumption of valuable time and resources while DNA analysts try to parse out unexplainable contributor profiles and an increased risk of identifying **false investigative leads** that could have been explained if appropriate **elimination samples** were available to the DNA analyst.

- ◆ **Elimination Sample:** A sample taken from an individual who had lawful access to the crime scene or crime laboratory.¹³
- ◆ **Elimination Database:** "A searchable collection of elimination profiles."¹⁴

Elimination Sample Considerations for Cold Case Investigations

The collection of **elimination samples** has not always been practiced, which may complicate the retesting of cold case evidence and **mixture interpretation**. The following documents and resources can be utilized in a retroactive case review to identify individuals who were present at the scene and may be contributing to a **mixture** profile:

- ◆ Crime scene photographs and videography
- ◆ Crime scene reports and supplemental documentation (e.g., entry/exit logs)
- ◆ Laboratory testing documentation
- ◆ Medicolegal investigation reports
- ◆ Interviews with personnel who were at the scene
- ◆ Archived newspaper articles/media interviews
- ◆ Reports or interviews from other involved agencies (e.g., first responders and coroners)

* Reference Appendix A for a sample Elimination Database Sample Consent Form to be adapted by your agency.

Activity

Mixture Concepts

Mixtures containing DNA profiles from multiple individuals are a common occurrence with touch DNA analysis. Control, reference, and elimination samples can help the DNA analyst develop profiles from a mixture that are relevant to the investigation.

Can you identify whether the following statements regarding mixtures are true or false?

Reference Appendix G for correct answer choices and reasonings.

1

Control samples are samples taken from an individual who had lawful access to either the crime scene or the crime laboratory.

A. True

B. False

2

Elimination databases should **only** include DNA samples of those who work directly in the crime laboratory with evidence processing after collection and transport of evidence is complete.

A. True

B. False

3

Obtaining **reference samples** from non-criminal justice individuals who were at the scene of the crime, whether directly or indirectly involved, can be beneficial when DNA analysts need to separate out and interpret a mixture profile.

A. True

B. False

4

Mixtures are biological samples that originate from at least **three** or more donors.

A. True

B. False

Call to Action

Discuss these topics with your **multidisciplinary team (MDT)**.

Does the laboratory have nonmanual capabilities to sort out **mixtures** (i.e., **PGS**)?

Does the laboratory have any policies in place for obtaining **elimination samples** from criminal justice professionals to be uploaded into a searchable **elimination database**?

Case-specific: Are there any **reference, control,** or **elimination samples** that should be collected, if possible, that can help identify background or contaminate DNA from a mixed sample?

Case-specific: Given the background of the case and the resulting **mixture** profiles, what factors should be considered for the possibility of **indirect transfer**?

Key Takeaways

Mixtures

Mixtures containing suspect, victim, and possible uninvolved individuals' DNA as a result of background DNA or a contamination event are common in touch DNA analysis. Having control, reference, and elimination samples for the laboratory can aid in the separation of mixture profiles.

Elimination samples should be obtained from all allied criminal justice professionals who had lawful access to the crime scene, and for individuals who had contact with the evidence during collection, handling, storing, and analysis. These samples aid in mixture interpretation and help identify profiles that have resulted from contamination events.

Elimination databases consisting of all allied criminal justice professionals are very beneficial to laboratory personnel. Elimination databases should be formed to aid in determining which profiles are potential false investigative leads in an investigation.

Notes

Mixtures

Sample Consumption Considerations

Learning Objectives

- ◆ Develop an understanding of the common complications of touch DNA evidence, such as low-quality and low-quantity samples, and how these lead to the need for full sample consumption
- ◆ Understand the importance of developing and adhering to a sample consumption policy and accompanying guidelines for submitting touch DNA evidence for testing and analyses

MOCK CASE STUDY

Full Sample Consumption Leads to Cold Case Resolution

A 1997 aggravated assault case had one item remaining for DNA testing: a condom wrapper the perpetrator used. The condom wrapper had been stored in less-than-ideal environmental conditions because of a lack of appropriate storage space in the property and evidence section. Because of the evidence degradation caused by these environmental impacts, it was assumed that the condom wrapper would present a low-quantity and low-quality DNA sample. After a consultation with laboratory staff, the lead investigator was advised that it would be best to fully consume a sample obtained from the condom wrapper that potentially contains deposited DNA from the perpetrator, as only sampling a portion would not lead to optimal results. The lead investigator agreed to this, acknowledging it was the last evidence item remaining in the case, and gave authorization to the laboratory to fully consume the sample to be taken from the evidence item. The laboratory sampled the condom wrapper for touch DNA with a cotton swab and proceeded through the analysis workflow. The testing of the condom wrapper yielded a partial DNA profile that hit in CODIS to a known serial sex offender, who was subsequently found guilty and sentenced with life in prison.

What Is Sample Consumption?

When submitting evidence to the laboratory for DNA analysis, law enforcement should advise whether the laboratory has permission to **consume** the entire sample, or whether they want to preserve some of the sample for additional DNA testing.

Consumption: The amount of sample that is depleted throughout the DNA processing of an evidence item. A sample is considered **fully consumed** when there is no remaining DNA sample left for additional DNA testing.

When evidence containing biological fluid is submitted to the laboratory for DNA analysis, it is common practice to only sample up to half of a stain to preserve the remaining portion of the evidence for future DNA analysis, if necessary.

Because of the general characteristics and nature of touch DNA, this evidence typically contains DNA that is low in both **quantity** and **quality**; therefore the technique of preserving half of a sample is **not** recommended for touch DNA evidence.

- ◆ **Quantity:** How much human DNA is present within a sample obtained from an evidence item.
- ◆ **Quality:** Refers to the value and usability of the sample, which is determined after DNA analysis occurs.

Assessing Quantity and Quality of Touch DNA Samples

Once DNA is extracted from an item of evidence, the laboratory assesses the DNA's **quantity**. This **quantification** assessment helps determine whether there is enough human DNA present to continue through the DNA analysis process.

Touch DNA samples are characteristically low in **quantity**, and it is known that additional DNA will likely be lost during the **extraction phase**.^{*} If the laboratory extracts DNA from half of a sample and finds the **quantity** is too low to proceed with DNA analysis, a second **extraction** from the remaining portion would be necessary. By extracting DNA twice, there is an increased risk of losing twice as much DNA than would have been lost if the sample was subjected to full consumption at the onset of the testing process.

The **quantity** and **quality** of a sample may be further decreased because of the principle of **homogeneity**.

- ◆ **Homogeneity:** A sample with the same DNA content (quantity and quality) throughout.

Because of the way touch DNA is deposited and transferred to an item or surface and the complications that arise with collecting this type of evidence, these samples may not be homogenous in nature. This means that if only up to half of a sample was utilized, it may possess a different **quantity** and **quality** of DNA than the other half. This can lead to unusable profiles being generated with no opportunity to go back and retest the reserved sample, as there may not be enough usable DNA to proceed with the analysis process.

Best Practices for Submission of Touch DNA Evidence

Because of the risks associated with low-quantity and low-quality DNA evidence, as commonly seen in touch DNA evidence, it is recommended that this type of evidence be considered for **full consumption**; therefore, this evidence should be treated with extreme care and caution.

Law enforcement investigators should discuss all touch DNA evidence laboratory submission cases with their **multidisciplinary team (MDT)** and laboratory staff **before** sending evidence to the laboratory for DNA testing. This conversation will aid in informing law enforcement investigators of which evidence to submit for the highest

^{*} Reference Section 2, Variables Affecting the Transfer and Recovery of Touch DNA, for more information on laboratory procedures.

Touch DNA Mixture Limitations

Recent advances within DNA testing have resulted in methods that are more sensitive to DNA, meaning less DNA is needed to generate a profile. Although this is a great achievement for touch DNA profiles, which often contain low levels of DNA, special considerations should be given to touch DNA **mixture** samples. The less DNA present within a **mixture** of two or more individuals, the greater the risk of there not being enough DNA from **each** individual contributing to the sample. Thus, separation and identification of these individuals may be complicated, or even unachievable. Furthermore, although **quantification** can provide insight as to how much DNA is present within a sample, it **cannot** determine the number of contributing individuals present within the sample.

possibility of achieving **probative** DNA results, based on the available testing capabilities at their laboratory. This discussion can also aid in determining whether it would be in law enforcement's best interest to test, or not test, an evidence item given current DNA technologies.

Touch DNA evidence items that typically require **full consumption** are those that have a small surface area or have an increased possibility of **background DNA**.

Small Surface Area	Background DNA
<ul style="list-style-type: none"> ◆ Ammunition and cartridge casings ◆ Smooth surface ligatures (zip ties, electrical cords) 	<ul style="list-style-type: none"> ◆ Sexual assault evidence (skin swabs, condom wrappers) ◆ Surface swabs (cellphones, doorknobs, vehicles)

Sample Consumption Policy and Guidelines

It is imperative that laboratories, alongside law enforcement, implement and strictly enforce a sample consumption policy and guideline checklist for the testing of touch DNA evidence, especially for items originating from cold cases. This policy should include an **Authorization for Consumption of DNA Sample Form** which should be signed by all individuals involved in the case (e.g., law enforcement investigators, prosecution) **before** submitting the evidence item

to the laboratory for testing to avoid delays in processing and the generation of backlogs within the laboratory. Furthermore, to streamline the submission process, this policy should include applicable guidelines that can help inform law enforcement investigators of how to determine which touch DNA evidence items would be appropriate to submit for testing given the relevant information surrounding the case. At a minimum, the following checklist should be considered when creating or updating a sample consumption policy for your agency.

Checklist for Sample Consumption Policy Creation*

Authorization for Consumption of DNA Sample Form	DNA Sample Consumption Guideline Checklist
<ul style="list-style-type: none"> <input type="checkbox"/> A statement indicating why some evidence items need to be fully consumed during the DNA process. <input type="checkbox"/> Whether this form will be utilized for any future evidence items submitted for the case. <input type="checkbox"/> Fill in the blanks for submitting agency, to include case number, name of agency representative, signature of the agency representative, and date. <input type="checkbox"/> If applicable: Fill in the blanks for prosecuting agency, to include name of prosecuting agency, name of the agency representative, signature of the agency representative, and date. 	<ul style="list-style-type: none"> <input type="checkbox"/> Is this the only evidence item belonging to the case, or are there additional items of evidence that could be considered for DNA testing? <input type="checkbox"/> Has the item previously been tested (for any type of DNA processing)? <input type="checkbox"/> If the item was previously tested, what were the results of the testing? <input type="checkbox"/> Has a discussion pertaining to the consumption of the item been held between all involved parties? <input type="checkbox"/> Does this item have a completed <i>Authorization for Consumption of DNA Sample Form</i> to be released to the laboratory?

* Reference Appendices B and C for a sample Authorization for Consumption of DNA Sample Form and sample DNA Sample Consumption Guideline Checklist for your agency to adapt.

Activity

Sample Consumption Considerations

Because of the nature and variables affecting touch DNA evidence, most of the samples obtained from these evidence items will need to be fully consumed during the DNA testing process.

Can you identify what evidentiary item would be most-appropriate to submit to the laboratory for consumption?

Reference Appendix G for correct answer choices and reasonings.

Select the most-appropriate answer choice.

1

A piece of cement used in a homicide case from 1998 is one of three stored items belonging to this case. The primary investigating officer has obtained an Authorization for Consumption of DNA Sample Form and signed it alongside of the acting prosecutor in the case. Would it be appropriate to submit this item to the laboratory for testing?

- A. Yes
- B. No

2

A manslaughter case from 2000 contains two evidentiary items: (1) a pair of shorts worn by the victim with a suspected bloodstain and (2) a baseball bat that the perpetrator handled. Which item would be appropriate to send to the laboratory for sample consumption?

- A. A cutting from the shorts
- B. A swab from the baseball bat

3

A condom wrapper used in a sexual assault case from 2005 is one of four evidence items belonging to this case. The primary investigating officer has not yet obtained a signed Authorization for Consumption of DNA Sample Form or consulted other involved criminal justice professionals. Would it be appropriate to submit this item to the laboratory for testing?

- A. Yes
- B. No

4

An aggravated assault case from 1995 contains two evidentiary items: (1) a ligature with an associated signed Authorization for Consumption of DNA Sample Form and (2) a box of ammunition heavily handled by the perpetrator with no associated Authorization for Consumption of DNA Sample Form. Which item would be appropriate to send to the laboratory for sample consumption?

- A. A cutting of the ligature
- B. A swab from the box of ammunition

Call to Action

Discuss these topics with your **multidisciplinary team (MDT)**.

Does the laboratory have a consumption policy for touch DNA evidence? If so, what steps does law enforcement need to take to have an evidence item approved for **consumption**?

Does the laboratory have a backlog in untested touch DNA evidence because of the delay in obtaining **consumption** requests? If so, what can law enforcement do to help mitigate this?

Are there any established guidelines that should be followed when determining whether an evidence item within a case should be considered for, or subjected to, **full consumption**?

Case-specific: Are there evidence items within this case that will require **full consumption** of the sample?

Key Takeaways

Sample Consumption Considerations

Touch DNA samples are typically composed of low-quality and low-quantity DNA. As a result, most touch DNA evidence samples will need to be fully consumed during the DNA testing process.

Any touch DNA evidence submitted to the laboratory for analysis should be accompanied by an *Authorization for Consumption of DNA Sample Form*. This should be signed by all individuals involved in the case (e.g., investigating officer and prosecuting/defense attorneys).

Notes

Sample Consumption Considerations

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SECTION 6

How Do I Decide What to Submit?

Learning Objectives

- ◆ Develop a process to effectively review all evidence items associated with a particular case
- ◆ Learn how to utilize your multidisciplinary team (MDT) to determine what evidence items will provide insight to lingering investigative questions through DNA testing

Cold case investigations face many unique challenges—it is not uncommon for cold case evidence and associated reports to have been lost or destroyed over the years. For law enforcement investigators to be able to effectively apply current DNA technologies to cold case investigations, it is imperative that they have a thorough understanding of the remaining evidence. By completing a comprehensive review of the evidence associated with a case, law enforcement will be able to work with their **MDT** to determine which items will aid in providing insight to outstanding **investigative questions** and which items would be best suited for submission to a laboratory. This process (as outlined below) comprises a systematic approach for reviewing a case to yield the most-effective outcome.

1. Conduct Evidence Reviews

To determine what evidence would be best suited for submission for touch DNA analysis, law enforcement investigators should have a thorough understanding of all evidence pertaining to a case. This includes identifying all collected evidence items and locating all relevant documentation such as chain of custody forms and laboratory reports from prior analyses. By compiling all relevant laboratory reports and developing a chain of custody for each individual item, informed decisions can be made regarding which pieces of evidence will have the highest likelihood of producing usable, **probative** results from touch DNA analysis.

Regardless of the type of crime or how old the case is, the following checklist should serve as an outline for law enforcement when compiling necessary details regarding potential touch DNA evidence submissions.

Evidence Review Checklist*

- Identify and document all evidence items associated with a case.** This can be accomplished by a thorough review of the associated casefile.
- Determine current disposition of each evidence item.**
- Take updated photographs of each remaining evidence item while abiding by proper evidence handling protocols** (e.g., photographs should be taken in an uncontaminated area and personal protective equipment should be used by all individuals handling the item).
- Compile all laboratory reports associated with each evidence item.** Reach out to all applicable laboratories and request they provide copies of all reports associated with the evidence.
- Compile a chain of custody for each evidence item.** Determine how the evidence item was collected, which individuals handled it, and where it was stored.

A basic spreadsheet can be used to document and organize the relevant information relating to the **evidence review**.

* Reference Appendices D and E for an expanded Evidence Review Checklist and Evidence Review Spreadsheet to be adapted by your agency.

What Do I Do If...

1. Evidence has been lost?
2. There are no laboratory reports?
3. There is no documented chain of custody?

ANSWER: Exhaust all efforts to locate evidentiary items and associated reports.

- ◆ **Ensure** all internal storage locations have been thoroughly searched. Consider offsite locations.
- ◆ **Contact** all agencies involved to determine whether they have custody of the physical evidence or any associated laboratory reports or chain of custody documents, including the medicolegal death investigator and local/state/federal/private laboratories.
- ◆ **Determine** what the common protocol was for documentation, storage and retention when the crime had occurred.
- ◆ **Utilize** your multidisciplinary team (**MDT**) to determine whether there are any remaining avenues to pursue.

2. Develop Investigative Questions

Once law enforcement investigators have completed a thorough review of all evidence items, **investigative questions** need to be developed. These questions should not be specific to any particular evidence item. Instead, law enforcement investigators should focus on outstanding case-related questions where insight can be gained through additional forensic testing, such as, “Who is the suspect?” or “Could the victim reasonably be placed in the person of interest’s vehicle?”

3. Establish a Testing Strategy

The final step in determining what evidence items to submit to the laboratory for touch DNA analysis is a consultation with a multidisciplinary team (**MDT**). Collaborating with a group of allied criminal justice professionals provides law enforcement with additional and alternative insights as to which evidentiary items would provide the most-optimal and most-relevant results through submission for touch DNA analysis. At a minimum, an established MDT should include the following roles:

- ◆ **Law Enforcement Investigators** provide information pertaining to the investigation such as the current status of the case and details related to the collection of all evidentiary items associated with a case.
- ◆ **Crime Laboratory Representatives** provide input on limitations of DNA testing techniques

and technologies, explain prior laboratory results, provide guidance on **outsourcing**, and aid in the process of **sample prioritization**.

- ◆ **Medicolegal Death Investigators** provide insight into postmortem examinations and information that can affect the suitability of evidence for submission (e.g., decomposition and time exposed to the elements).
- ◆ **Prosecutors** provide guidance on investigative steps that need to be taken for successful prosecution including information on the application of techniques and technologies to a case that will meet requirements for admissibility.
- ◆ **Victim/Family Advocates** provide guidance on how to take a **trauma-informed** and **victim-centered approach** when discussing testing of samples that may not have been beneficial to test in the past. This may include appropriate communication between the allied professionals and the community affected by the overall response effort.

After reviewing the evidence review spreadsheet/documentation check list, the MDT should work together to determine what evidence items should be tested (or retested) for the greatest opportunity of providing insight to the investigative questions posed by law enforcement. The MDT should take the following into consideration when developing this testing strategy:

- ◆ Is it possible **improper storage** of the evidence could have resulted in **contamination** (e.g., packaging multiple items together resulting in possible cross-contamination) or **degradation** (e.g., wet item originally stored in a plastic bag)?
- ◆ Is it possible that **improper handling** of the evidence could have resulted in **contamination** (e.g., initial investigator handled the item without gloves at the scene prior to packaging)?
- ◆ What is the likelihood this evidence item will **produce probative results**, taking into account prior analyses and handling/storage conditions?
- ◆ Are the testing results of this evidence item likely to **provide insight** to law enforcement's **investigative questions**?
- ◆ Can **elimination samples, reference samples, or control samples** be obtained to help parse out any possible mixtures?
- ◆ Does the local/state laboratory have the capabilities and resources to process an evidence item for touch DNA using the most appropriate **sampling technique**? If not, does law enforcement have the funding to **outsource** the item to another laboratory?
- ◆ If considering **outsourcing**, does your laboratory have an agreement with the outsourced laboratory to review the results and upload the information into the **Combined DNA Index System (CODIS)**? This agreement must be in place before testing begins.
- ◆ If considering submitting touch DNA evidence for Forensic Genetic Genealogy (FGG), given the current limitations with its ability to obtain usable FGG data from samples of low quantity and DNA contributed from multiple individuals, is it in the best interest of the case to proceed with this type of testing or wait until the technologies evolve to mitigate the current limitations?¹⁶

The Combined DNA Index System (CODIS)¹⁷

What Is CODIS and How Does It Work?

The **Combined DNA Index System (CODIS)** is a national DNA database created and maintained by the Federal Bureau of Investigation (FBI) that allows participating laboratories to search casework DNA samples. **CODIS** is comprised of three tiers, which allows for DNA profiles meeting certain requirements to be searched on local, state, and national levels. Forensic casework sample DNA, convicted offender DNA, unidentified human remains DNA, missing persons' biological relatives DNA, and arrestee DNA (if applicable dependent on individual state laws) are entered into this database and searched among previously entered DNA profiles. If an association between DNA profiles occurs, commonly referred to as a **hit**, laboratory personnel will confirm it through obtaining additional information on the **hit** profile and will notify the submitting law enforcement agency.

CODIS Participation Requirements

To participate in the National DNA Index of **CODIS**, laboratories must satisfy requirements established by the FBI. These requirements include compliance with the FBI's Quality Assurance Standards, **accreditation** through a nonprofit professional association universally accepted within the forensic science community (approved accrediting agencies include A2LA and ANAB), biennial audits to demonstrate compliance with the Quality Assurance Standards, and ensuring access to DNA samples and records are limited in accordance with federal laws and regulations. Further, the laboratory must identify as a federal, state, or local criminal justice agency.

CODIS Outsourcing Requirements

Forensic casework samples, convicted offender, unidentified human remains, missing persons' biological relatives, and arrestee DNA (if applicable dependent on individual state laws) may all be **outsourced** to another, non-parent laboratory, if necessary. Laboratories that receive **outsourced** samples must meet specific requirements established by the FBI's Quality Assurance Standards. Generally, these requirements state that your laboratory must have a **preexisting** agreement with an **accredited** laboratory that is in compliance with the FBI's Quality Assurance Standards. Furthermore, your laboratory must be willing to review the DNA results from the **outsourced** laboratory and, upon review, upload these results into **CODIS**.

Activity

How Do I Decide What to Submit?

When handling cold case evidence, it is of utmost importance to determine what to submit for touch DNA processing through a systematic approach that includes completion of an evidence review, development of investigative questions, and development of a testing strategy with your multidisciplinary team (MDT).

Can you identify the correct answer to the following cold case evidence submission concepts?

Reference Appendix G for correct answer choices and reasonings.

1

If you cannot locate a piece of evidence referenced in your casefile, what should be done?

- A.** Only contact the original investigating personnel (e.g., detective).
- B.** Ensure all storage locations (on- and off-site) have been thoroughly searched.
- C.** Refer to original documentation of the evidence item to determine its storage location.

2

What information should be collected during an evidence review?

- A.** Current disposition of each evidence item.
- B.** Previous laboratory submission forms and reports.
- C.** Original chain of custody forms, crime scene photographs, and other associated documentation.
- D.** A and B.
- E.** All of the above.

3

What can crime laboratory representatives contribute to your MDT?

- A.** Advise on sample prioritization.
- B.** Take updated photographs of evidence items.
- C.** Physically track down lost evidence items.

4

Which of the following answer choices shows the most-reasonable order of determining what evidence to submit to the laboratory?

- A.** Hold a consultation with your MDT, develop a testing strategy, review the casefile, develop investigative questions, identify all associated evidence, and physically locate evidence.
- B.** Develop investigative questions, review the casefile, physically locate evidence, identify all associated evidence, develop testing strategy, and hold a consultation with your MDT.
- C.** Review the casefile, identify all associated evidence, physically locate evidence, develop investigative questions, hold a consultation with your MDT, and develop testing strategy.

Call to Action

Discuss these topics with your **multidisciplinary team (MDT)**.

Does your agency have a developed **evidence review** checklist? If not, who would be the point of contact for the creation of one?

Does your agency's laboratory have an agreement and procedure set in place with a private laboratory for **outsourcing** evidence items for testing? What are this laboratory's capabilities and requirements for evidence submission?

Evidence Review in Practice

In January 1977, the body of an unidentified female was found in a wooded area off a heavily traveled highway. The medical examiner determined the Jane Doe died as a result of ligature strangulation. Witness statements early in the investigation provided law enforcement investigators with a person of interest (POI); however, no arrests were made because of a lack of incriminating evidence, and the victim remained unidentified. In 2019, Investigator A was assigned to this cold case. During a review of the casefile, Investigator A learned the following evidence items were collected in 1977: a sexual assault kit (SAK), two pieces of a shirt worn by the Jane Doe (one piece believed to have been used by the perpetrator as a ligature), fingernail clippings from the Jane Doe, a piece of stained carpet cut from the trunk of the POI's car, and a beer can.

Investigator A knows that by submitting the evidence to his agency's forensic laboratory for touch DNA testing, he may be able to identify both the victim and the perpetrator. Because of the age of the case and the possibility that all available evidence may be degraded, Investigator A felt a thorough evidence review and discussion with his **MDT** would be necessary to determine what pieces of evidence would likely yield the best results.

Investigator A began by compiling all reports associated with the evidence and spent time trying to physically locate each item. Investigator A surmised the sexual assault kit could potentially provide DNA profiles for both individuals; however, despite an exhaustive search, the SAK could not be found. Investigator A located and photographed both pieces of the shirt, the fingernail clippings, the cut piece of stained carpet from the trunk of the POI's car, and the beer can. Investigator A then consulted his MDT, providing information on the available evidence and requesting assistance in determining which evidence items could lend insight to his outstanding **investigative questions** (i.e., outstanding major case questions that law enforcement develop during the evidence review process to aid in determining which evidence will be most likely to provide insight to the case through DNA testing).

QUESTION 1: Can you think of some investigative questions that could lend insight in this case?

.....

.....

.....

Reference Appendix G to compare your questions to the investigative questions developed by Investigator A.

During the discussion, the MDT panel suggested the shirt used as a ligature may be a viable option for obtaining a suspect profile; however, Investigator A knew from reviewing reports and photographs that the ligature was handled by multiple criminal justice professionals at the crime scene without the use of gloves and was therefore likely contaminated.

The inside of the shirt worn by the victim could be submitted for touch DNA in an attempt to develop a victim profile, but because of the age of the case and environmental factors it had been exposed to in storage over the years, there was a chance the shirt would not produce usable results.

Because the SAK could not be located and the piece of shirt used as a ligature could not be used due to contamination, the MDT suggested the fingernail clippings as the next-best option to develop a suspect profile. However, given the totality of the evidence, the MDT ultimately decided the fingernail clippings should be reserved as a backup for obtaining a victim profile.

In a review of the casefile reports, the MDT learned that the beer can was one of many cans found less than one foot from the Jane Doe. The surrounding area was free of trash and debris. Based on this information, the MDT felt the can was likely connected to the crime and suggested it be submitted in an attempt to obtain a suspect profile.

Lastly, the MDT suggested that if a suspect profile could not be obtained, and if a victim profile was developed for comparison, the cut piece of stained carpet from the trunk of the POI's car should be submitted to determine whether the victim's DNA could be found. If the victim's profile was identified in the stain, this would place the victim in the POI's car, providing additional circumstantial evidence.

QUESTION 2: Consider the evidence items below:

- ◆ Victim's fingernail clippings
- ◆ 2 pieces of the victim's shirt
- ◆ A beer can found near the victim's body
- ◆ A cut piece of stained carpet from the trunk of the POI's car

What would your developed testing strategy be (i.e., which items would you submit to the laboratory for touch DNA testing and in what order should they be tested)?

.....

.....

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.....

Reference Appendix G to compare your answer to the forensic testing strategy developed by Investigator A and the other MDT members.

Glossary

Accreditation: The verification that a laboratory possesses and maintains a quality management system and technical capabilities that meet the requirements and standards established by an accrediting body.

Amplification: The process of making numerous copies of human DNA.

Area of contact: The surface area of the object that an individual touched.

Background DNA: DNA that already existed on the item before the crime.

Cellular material: Deposited cells that may contain human DNA that can be extracted for further analysis.

Combined DNA Index System (CODIS): The National DNA Database created and maintained by the Federal Bureau of Investigation that allows participating laboratories to search casework DNA samples.

Consumption: The amount of sample that is depleted throughout the DNA processing of an evidence item. A sample is considered fully consumed when there is no remaining DNA sample left for additional testing.

Contamination: The transfer of DNA to an object, surface, or individual after the crime occurred, which could be from non-involved individuals present at the scene, allied criminal justice professionals that handled evidentiary items during or after collection, or by means of multiple collected evidentiary items packaged and stored together.

Control sample (blank sample): "A sample of a known source that was presumably uncontaminated during the commission of a crime."¹³

Cutting: A common collection technique where a portion of an evidentiary item is cut to obtain a sample of the DNA.

Degradation: The fragmenting, or breakdown, of DNA by chemical, physical, or biological means; this is a common occurrence when biological samples containing DNA encounter non-ideal environments such as extreme heat, moisture, or UV light.

Direct transfer: Occurs when an individual's DNA is transferred to an object or surface through touching it with their bare hands, or by wearing an item that comes into contact with their skin. A direct transfer event may also occur between two individuals.

Double swabbing: A common collection technique in which two swabs are used to sample DNA on an evidentiary item, typically by using one wet swab followed by one dry swab on the same area of interest.

Duration: How long an individual handled an item or surface.

Elimination database: "A searchable collection of elimination profiles."¹⁴

Elimination sample: A sample taken from an individual who had lawful access to the crime scene or crime laboratory.¹³

Evidence review: A process in which law enforcement gathers all relevant information pertaining to the evidence in a case.

Exclusion: An individual who can reasonably be removed as a potential contributor to a DNA sample.

Extraction: The removal of DNA from the cells in which it resides.

False investigative lead: A lead of no relevance to the investigation, developed through a contamination event presented in a DNA mixture.

Full consumption: Occurs when there is no remaining DNA sample for additional DNA testing.

Handler: The individual using or touching the item during the crime, associated with one-time use or contact.

Hit: A term utilized when an association between two DNA profiles occurs through CODIS.

Homogeneity: A sample with same DNA content (quality and quantity) throughout.

Inclusion: An individual who cannot reasonably be removed as a potential contributor to a DNA sample.

Glossary (continued)

Indirect transfer: Occurs when DNA from an individual ends up on an object, surface, or individual they did not directly touch or make contact with.

Interpretation: The final process in a DNA workflow, in which laboratory personnel analyze the resulting DNA profile(s). This process occurs for all resulting DNA profiles, including mixtures.

Investigative questions: Outstanding major case questions that law enforcement develop during the evidence review process. These questions will aid in determining which evidence will be most likely to provide insight to the case through DNA testing.

Locard's exchange principle: The founding principle of trace evidence, briefly summarized as "every contact leaves a trace."

Major contributor: The individual(s) contributing more DNA to a mixture, in which the associated profile would be considered a major profile.

Major profile: The profile developed of the major contributor in a DNA mixture.

Manner: The way an individual handled an item or surface.

Minor contributor: The individual(s) contributing less DNA to a mixture, in which the associated profile would be considered a minor profile.

Minor profile: The profile developed of the minor contributor in a DNA mixture.

Mixture: "A biological sample that originated from two or more donors and is determined after a DNA profile is generated."¹²

Multidisciplinary team (MDT): A working group of allied criminal justice professionals that meets regularly to discuss factors related to unresolved cold cases. These factors may be case-specific, such as the review of evidentiary items to determine suitability for laboratory submission, or broader factors, such as ensuring cold case investigation protocols are systematic and are in line with a trauma-informed and victim-centered approach.

M-Vac: An alternative collection technique where a wet vacuum is utilized to collect cellular material from an evidentiary item.

Non-porous: A substrate that does not contain minute spaces where DNA would be more-easily retained.

Non-self DNA: DNA deposited from an unrelated, noninvolved individual as a result of an indirect transfer event.

Non-shedder: An individual who is less likely to leave behind DNA more naturally.

Outsourcing: The process of seeking services for DNA testing from an outside, nonparent-agency laboratory.

Persistence: The length of time and extent in which DNA exists on an item or surface.

Porous: A substrate that contains minute spaces that retain deposited touch DNA.

Probabilistic Genotyping Software (PGS): Software developed to provide a nonmanual, more-objective approach to DNA profile interpretation.

Probative: Demonstrating proof or evidence of something.

Quality: Refers to the value and usability of the sample, which is determined after DNA analysis occurs.

Quantification: Determination of the concentration of human DNA to inform downstream processing.

Quantity: How much human DNA is present within a sample obtained from an evidence item.

Reference sample (standard sample): A sample that can be compared to a known profile in a forensic casework sample that shows association between the crime scene, perpetrator, or victim.¹³

Sample prioritization: The process of determining the best order to submit evidentiary items to the laboratory based on which items are most likely to yield probative DNA results. This process is typically led by the laboratory representative on a multidisciplinary team (MDT).

Glossary *(continued)*

Sampling technique: Techniques used by DNA analysts to attempt to collect DNA from an evidentiary item.

Scraping: A common collection technique in which a portion of an evidentiary item is scraped utilizing a sharp metal blade, such as a scalpel, to obtain a sample of the DNA.

Semi-porous: A substrate that demonstrates qualities of being both porous and non-porous.

Shedder: An individual who tends to leave behind DNA more naturally.

Shedder status: Used to discuss an individual's ability to deposit touch DNA on a surface or object through direct contact.⁶

Soaking: An alternative collection technique commonly employed for small evidentiary items where the entire item is soaked in a solution typically used in DNA extraction, causing cellular material to break open and release DNA for sampling purposes.

Substrate: The surface of a material on which touch DNA is deposited.

Swabbing: A common collection technique utilizing a cotton swab to sample DNA on an evidentiary item.

Tape-lift: A common collection technique utilizing the adhesive side of tape to collect cellular material from an evidentiary item.

Testing Strategy: A strategy developed through MDT consultation that considers sample prioritization principles and delineates the evidentiary items to be submitted to the laboratory for DNA testing that are most likely to provide insight to outstanding investigative questions.

Touch deposit: The transfer of touch DNA to an object, surface or individual during the crime.

Touch DNA (or trace DNA): "The DNA that is left behind from skin cells when a person touches or comes into contact with an item."¹

Trace evidence: Evidence created when human DNA comes into contact with an item, object, surface, or another individual and is typically invisible to the naked, unaided eye.

Trauma-informed approach: An approach involving educating victims, service providers, and the general community about the impact of trauma on the health and well-being of victims; attending to victims' emotional and physical safety; and using resources, services, and support to increase the ability of victims to recover.

Validation: The process of establishing assurance that a methodology, technique, or procedure will consistently perform and produce reliable results that meet established, predetermined requirements.

Victim-centered approach: An approach placing the victim at the center of all decisions regarding victim recovery and involvement within the criminal justice system; focusing on victim's choice, safety, and well-being; and how the needs of the victim are the concern of all involved professionals.

Wearer: The habitual user of an item.

Appendices

The following appendices are designed to be adapted for implementation and use in your agency.

Appendix A: Elimination Database Sample Consent Form

Appendix B: Authorization for Consumption of DNA Sample Form

Appendix C: DNA Sample Consumption Guideline Checklist

Appendix D: Evidence Review Checklist

Appendix E: Evidence Review Spreadsheet

Appendix F: Resources for Agencies Pursuing Cold Case Investigations

Appendix G: Activity Answers and Reasonings

CRIME LABORATORY DIVISION
ELIMINATION DATABASE SAMPLE CONSENT FORM

When DNA mixtures present themselves after DNA testing and analysis has occurred, it is possible that unexplainable profiles may be the result of a contamination event from an allied criminal justice professional who collected, handled, processed, or otherwise interacted with an evidence item. The presence of unexplainable contributors can lead to confusion as to the relevance of the profile in the context of a case. To mitigate these occurrences, the _____ has implemented a searchable elimination database consisting of all associated employees, including laboratory staff, crime scene investigators, law enforcement personnel and detectives, medicolegal death investigators, and property and evidence custodians. The _____ requests that all employees submit a buccal swab for elimination sample purposes as a condition of employment with _____. These samples will be entered into the database with an ID number assigned to each employee. If a contamination event occurs and an elimination sample is determined to be associated with the unexplained profile, the employee's name will not be associated with the laboratory report that will be provided to the relevant investigating agency to inform them of the contamination event. If a contamination event occurs, this should not be handled in a punitive manner, but rather should be viewed as an opportunity to provide more training to personnel to prevent repeated occurrences.

This practice is in accordance with and protected by the [United States Genetic Information Nondiscrimination Act of 2008 Section 1635.8](#).

EMPLOYEE'S INFORMATION AND AUTHORIZATION

I, the undersigned individual, am an allied criminal justice professional employed by _____. I hereby give permission to the _____ to obtain a buccal swab and use this sample for the purpose of elimination where contamination should occur in a casework DNA sample leading to the development of an unexplainable DNA profile.

NAME OF EMPLOYEE

EMPLOYEE'S DEPARTMENT

PRINTED NAME OF EMPLOYEE

EMPLOYEE'S POSITION/TITLE

SIGNATURE OF EMPLOYEE

DATE OF SIGNATURE

CRIME LABORATORY DIVISION
AUTHORIZATION FOR CONSUMPTION OF DNA SAMPLE FORM

Certain DNA samples obtained from evidence items are required to be consumed for DNA analysis to provide the most-beneficial result and yield the most-usable DNA profile(s). Samples that commonly require full consumption are those from cold case investigations, specifically those submitted for touch DNA analysis. The _____ will make every effort to preserve the DNA sample and DNA extract if possible. However, because full sample consumption may be determined to be required, the _____ requires that the submitting agency and prosecuting agency (if applicable) acknowledge this practice and authorize full sample consumption. This authorization for DNA sample consumption form should accompany the processing request form(s) sent to the _____ to avoid increased turnaround times and bottlenecks in laboratory processing workflows.

SUBMITTING AGENCY

I, the undersigned individual, am a representative of the submitting agency and authorize the _____ to fully consume this DNA sample if laboratory personnel determine full DNA sample consumption to be required.

NAME OF SUBMITTING AGENCY

SUBMITTING AGENCY CASE NUMBER

PRINTED NAME OF AGENCY REPRESENTATIVE

CASE NUMBER (IF APPLICABLE)

SIGNATURE OF AGENCY REPRESENTATIVE

TITLE/RANK OF REPRESENTATIVE

REPRESENTATIVE'S RELATION TO CASE

DATE OF SIGNATURE

SUBMITTING AGENCY

I, the undersigned individual, am a representative of the prosecuting agency and authorize the _____ to fully consume this DNA sample if laboratory personnel determine full DNA sample consumption to be required.

NAME OF PROSECUTING AGENCY

SUBMITTING AGENCY CASE NUMBER

PRINTED NAME OF AGENCY REPRESENTATIVE

CASE NUMBER (IF APPLICABLE)

SIGNATURE OF AGENCY REPRESENTATIVE

TITLE/RANK OF REPRESENTATIVE

REPRESENTATIVE'S RELATION TO CASE

DATE OF SIGNATURE

DNA SAMPLE CONSUMPTION GUIDELINE CHECKLIST

The checklist below will aid law enforcement investigators in making decisions regarding whether a DNA sample from an evidence item is appropriate to submit to the laboratory for touch DNA analysis. Some of the following questions may not be pertinent to the case at hand or may be unanswerable because of potential gaps in relevant evidence item and case information. However, the more information that can be obtained and used to complete this checklist, the more confident law enforcement investigators can be in proceeding with a laboratory request submission that will likely require full DNA sample consumption.

RELEVANT EVIDENCE ITEM AND CASE INFORMATION

<hr/> CASE NUMBER	<hr/> CRIME TYPE
<hr/> DATE OF INCIDENT	<hr/> EVIDENCE ITEM OF INTEREST AND ITEM NUMBER
<hr/> NAME OF INDIVIDUAL COMPLETING THIS FORM	<hr/> TITLE/RANK OF INDIVIDUAL
<hr/> INDIVIDUAL'S RELATION TO CASE	<hr/> DATE OF COMPLETION

Has this evidence item previously been sent to the laboratory for DNA testing? (Y/N) _____

- ◆ When was the DNA testing completed? _____
- ◆ What kind of prior DNA testing was completed? _____
- ◆ What were the results of this testing? _____

Have all individuals involved in this investigation been contacted regarding the consideration to submit this evidence item for touch DNA analysis? (Y/N) _____

- ◆ The following individuals have been contacted and **are** in agreement with proceeding with this process: _____
- ◆ The following individuals have been contacted and **are not** in agreement with proceeding with this process: _____
- ◆ The following individuals have yet to be contacted: _____

Has an associated authorization for DNA sample consumption form been discussed between the submitting agency and prosecuting agency (if applicable) for this evidence item? (Y/N) _____

- ◆ Will this form be fully completed and signed to accompany the laboratory request submission for this evidence item? (Y/N) _____

DNA SAMPLE CONSUMPTION GUIDELINE CHECKLIST *(continued)*

How many evidence items are associated with this case? _____

- ◆ If there is more than one item of evidence, would these other items potentially require full DNA sample consumption? (Y/N) _____
- ◆ Could these other evidence items be submitted to the laboratory for another type of DNA testing beyond touch DNA analysis? (Y/N) _____

If other evidence items exist, have they previously been submitted to the laboratory for DNA testing? (Y/N) _____

- ◆ Which evidence items have previously been tested? _____
- ◆ When was the DNA testing completed? _____
- ◆ What kind of tests were completed? _____
- ◆ What were the results of these tests? _____

EVIDENCE REVIEW CHECKLIST

The checklist below will guide law enforcement investigators through the process of reviewing evidence associated with a cold case investigation. A thorough review of all evidence, in conjunction with a consultation with a multidisciplinary team (MDT), will aid in determining which items may help address outstanding investigation questions and would be best-suited for submission to a laboratory for touch DNA analysis.

AGENCY CASE NUMBER

DATE OF INCIDENT

BRIEF SYNOPSIS

Step 1: Evidence Review

- ◆ In a [basic spreadsheet](#), identify and document all evidence items associated with the case. This can be accomplished by a thorough review of the associated case file
 - Each evidence item should have a unique reference number.
 - Determine when and where each evidence item was collected.
 - Determine the relevance of each evidence item to the investigation (e.g., “Evidence Item A2: Cigarette butt found next to victim’s body”).
- ◆ Determine current disposition of each evidence item.
 - Note the physical location where each evidence item is **tangibly** located (relying on old documentation is not acceptable, as the evidence item may have been moved without it being documented).
 - If an evidence item cannot be found, exhaust all efforts to locate or provide documentation to show possible DNA sample consumption or when the evidence item was lost/destroyed. Consider the following:
 - Ensure all on-site storage locations have been thoroughly searched—consider offsite locations as well.
 - Contact all agencies involved, including the medicolegal death investigator and local/state/federal/private laboratories, to determine whether they have custody of the physical evidence or if they have any associated laboratory reports or chain of custody documents.

EVIDENCE REVIEW CHECKLIST *(continued)*

- Determine what the common protocol was when the original investigation occurred. Did your agency outsource to a particular laboratory? Where was evidence typically stored? What was the evidence retention policy at that time?
- Use your MDT to determine whether there are any remaining avenues to pursue.
- ♦ Take updated photographs of each remaining evidence item while abiding by proper evidence handling protocols (e.g., photographs should be taken in an uncontaminated area, personal protective equipment should be used by **all** individuals handling the item).
- ♦ Compile all laboratory reports associated with each evidence item. Reach out to all applicable laboratories and request they provide copies of **ALL** reports associated with the evidence. The following specific details should be obtained:
 - Laboratory reference number(s)
 - Date(s) of submission
 - Date(s) of testing
 - Type(s) of testing completed
 - Testing result(s)
 - Did the testing result in a CODIS-eligible profile?
 - Has that CODIS-eligible profile been entered and uploaded to CODIS?
 - If a developed profile has not been entered and uploaded to CODIS, why?
- ♦ Compile a chain of custody for each evidence item. Determine how the evidence item was collected, which individuals handled it, and where it was stored.

Step 2: Developing Investigative Questions

- ♦ After conducting a review of the case file, law enforcement investigators should identify outstanding investigative questions. These questions should not be specific to any particular evidence item. Instead, investigators should focus on outstanding case-related questions that forensic testing may be able to provide insight to, such as, “Who is the suspect?” or “Could the victim reasonably be placed in the person of interest’s vehicle?”
- ♦ Document your investigative questions here:

EVIDENCE REVIEW CHECKLIST *(continued)*

Step 3: Use Your Multidisciplinary Team (MDT) to Develop a Testing Strategy

- ◆ Determine who will be on your MDT if it is not already established. At a minimum, the MDT should consist of:
 - **Law Enforcement Investigators:** provide information pertaining to the investigation such as the current status of the case and details related to the collection of all evidentiary items associated with a case.
 - **Crime Laboratory Representatives:** provide input on limitations of DNA testing techniques and technologies, explain prior laboratory results, provide guidance on outsourcing, and aid in the process of sample prioritization.
 - **Medicolegal Death Investigators:** provide insight into postmortem examinations and information that can affect the suitability of evidence for submission (e.g., decomposition and time exposed to the elements).
 - **Prosecutors:** provide guidance on investigative steps that need to be taken for successful prosecution including information on the application of techniques and technologies to a case that will meet requirements for admissibility.
 - **Victim/Family Advocates:** provide guidance on how to use trauma-informed and victim-centered approaches when discussing testing of DNA samples that may not have been beneficial to test in the past. This may include appropriate communication between the allied criminal justice professionals and the community affected by the overall response effort.
- ◆ Schedule a meeting with your MDT to discuss possible evidence submission for the case.
Date of MDT meeting: _____
- ◆ Draft a case summary and provide the narrative to your MDT before your meeting, along with a copy of your evidence review spreadsheet. This will give the MDT a thorough understanding of the evidence and each item's relevance to the investigation.
Date narrative and spreadsheet sent to MDT: _____
- ◆ Facilitate a discussion amongst the MDT to determine what evidence items should be tested (or retested) to provide the best chance of answering the investigative questions you have listed above. The MDT should take the following into consideration when developing this testing strategy:
 - What is the likelihood that this evidence item will produce viable results, taking into account prior testing and handling/storage conditions?
 - Are the testing results of this evidence item likely to provide insight to the developed investigative questions?
 - Does the local/state/federal laboratory have the capability to process the evidence item for touch DNA using the most-appropriate DNA sampling technique? If not, does the law enforcement agency have the funding to outsource the item to another laboratory?
 - Can elimination, reference, or control samples be obtained to help parse out any possible mixtures?
- ◆ Draft a testing plan and share the plan with your MDT for final review and input.
Date testing plan provided to MDT for review: _____
- ◆ Once a consensus has been reached between all MDT members, submit evidence to the appropriate laboratory, as outlined by the testing plan.

EVIDENCE REVIEW SPREADSHEET

Agency case number	
Evidence item number	
Item description	
Date and time collected	
Location collected (e.g., on victim's person; backseat of specific vehicle)	
Has the item been physically located? (Y/N)	
Current disposition	
Has the item been photographed during this review? (Y/N)	
Is a complete chain of custody available? (Y/N)	
Brief description of how item has been stored since collection (i.e., locations and under what conditions)	
Has the item been previously submitted for forensic testing? (Y/N)	
Name of Laboratory 1	
Laboratory 1 reference number	
Testing performed by Laboratory 1	
Did Laboratory 1 develop a DNA profile? (Y/N)	
Has the DNA profile developed by Laboratory 1 been entered and uploaded to CODIS? (Y/N)	
If a developed profile from Laboratory 1 has NOT been entered and uploaded to CODIS, provide a brief statement explaining why (e.g., partial profile, developed by a laboratory that does not participate in CODIS)	
Are Laboratory 1 reports available for this analysis? (Y/N)	

EVIDENCE REVIEW SPREADSHEET *(continued)*

Does the agency have copies of all Laboratory 1 reports? (Y/N)	
Name of Laboratory 2	
Laboratory 2 reference number	
Testing performed by Laboratory 2	
Did Laboratory 2 develop a DNA profile? (Y/N)	
Has the DNA profile developed by Laboratory 2 been entered and uploaded to CODIS? (Y/N)	
If a developed profile from Laboratory 2 has NOT been entered and uploaded to CODIS, provide a brief statement explaining why (e.g., partial profile, developed by a laboratory that does not participate in CODIS)	
Are Laboratory 2 reports available for this analysis? (Y/N)	
Does the agency have copies of all Laboratory 2 reports? (Y/N)	
Notes (this can include pending questions to discuss with laboratory personnel/multidisciplinary team, investigative questions that could be answered with further testing, contamination concerns, etc.)	

RESOURCES FOR AGENCIES PURSUING COLD CASE INVESTIGATIONS

FUNDING

Oftentimes, many law enforcement agencies are not able to reopen cold case investigations because of budget concerns leading to lack of financial ability to fund additional/support staffing, travel, outsourcing to forensic laboratories, and consultation/contractor services. All these elements, along with various other investigative support resources, are needed to pursue cold case investigations. To mitigate financial resource concerns, there are grants available through the Bureau of Justice Assistance (BJA), a program established and maintained by the United States Department of Justice's Office of Justice Programs, to support law enforcement agencies seeking to pursue cold case investigations. The following grants are currently in existence and may be able to financially assist your agency.

The Bureau of Justice Assistance's Prosecuting Cold Cases Using DNA Grant

This grant is offered for the primary purpose of dispersing funding to increase the capacity of state and local prosecution offices to address and resolve violent crime cold cases. Secondary objectives include supporting increased capacity for identifying, locating, collecting, processing, and analyzing evidence (including non-DNA evidence) to assist prosecutors with the litigation of violent crime cold cases. This grant requires a DNA profile from a suspect to have been developed, however, the suspect's identity can be known or unknown at the time of application. Funding support may be used for investigative activities (such as interviewing victims, witnesses, and suspects) and crime and forensic analyses that aid in prosecuting violent crime cold cases. Funding may also be used for salary and benefits of additional employees (full-time or part-time) that will be directly engaged in the investigation, overtime for existing employees (directly involved in adjudication, case review, investigation, location of evidence, crime analysis, and forensic analysis of evidence), limited travel for expenses related to investigative purposes, limited computer equipment used exclusively for related activities, hiring of consultation or temporary contractor staff to conduct case review, investigations, location of evidence, forensic analyses, and outsourcing of evidence for forensic analyses through contracts with accredited fee-for-service laboratories. In the fiscal year of 2021, BJA offered 10 total awards with a maximum funding of \$470,000 for each award.

For more information on what constitutes a violent crime cold case, applicant eligibility, and required application documentation, please visit [Prosecuting Cold Cases Using DNA](#).

The Bureau of Justice Assistance's Emmett Till Cold Case Investigations Program Grant

This grant is offered to fund grants to state, local, and tribal law enforcement and prosecution agencies to support expenses associated with the investigation and prosecution of unsolved homicide cold case murders that are suspected to be racially motivated and occurred no later than December 31, 1979. Funding may be used for evidence reviews and use of modern DNA and forensic tools to aid investigations; staffing; costs associated with processing crime scene and other evidence, including forensic evidence and crime laboratory associated costs; costs for expert testimony; case preparation; investigation and prosecution; support to family members and stakeholders affected by these cases; and to inventory, track, investigate, and prosecute the case. In the fiscal year of 2021, BJA offered seven total awards with a maximum amount of funding for six awards at \$500,000 and one award at \$325,000, dependent on the category of funding applied for.

For more information on applicant eligibility and required application documentation, please visit [Emmett Till Cold Case Investigations and Prosecution Program](#).

RESOURCES FOR AGENCIES PURSUING COLD CASE INVESTIGATIONS *(continued)*

The National Sexual Assault Kit Initiative (SAKI)

SAKI provides funding to support the jurisdictional reform of approaches to sexual assault cases resulting from evidence found in sexual assault kits that have never been submitted to a crime laboratory. The primary aims of SAKI include resolving sexual assault cases through a comprehensive and victim-centered approach, aiding increase of jurisdictional capacity-building to prevent high numbers of unsubmitted sexual assault kits in the future, and supporting the investigation and prosecution of cases for sexual assault kits that were previously unsubmitted.

For more information on SAKI and future funding opportunities, please visit [Sexual Assault Kit Initiative](#).

SUPPORTIVE INITIATIVES AND ORGANIZATIONS

In addition to funding opportunities, a plethora of initiatives and organizations have been developed to support law enforcement agencies pursuing cold case investigations. Furthermore, many of these also offer training opportunities, at no cost to the agency, to learn more about best practices and the development of systematic procedures to be applied to cold case investigation and prosecution.

The Federal Bureau of Investigation's Cold Case Initiative

Started in 2006, the Federal Bureau of Investigation began its Cold Case Initiative with a primary focus on identifying and investigating racially motivated cold case murders that occurred no later than December 31, 1979. For cases in which prosecution is no longer feasible, this initiative also strives to support family members of victims who have been affected by the case. Further, this initiative trains various requesting community groups on the Emmett Till Unsolved Civil Rights Crime Act (2008).

For more information regarding the Federal Bureau of Investigation's Cold Case Initiative, please visit [Cold Case Initiative](#).

The Federal Bureau of Investigation's National Center for the Analysis of Violent Crime

This program provides investigative and operational support functions, research, and training with the goal of assisting federal, state, local, and foreign law enforcement agencies investigating unusual or repetitive violent crimes. The Federal Bureau of Investigation offers this program at no charge to the agency. The program consists of three components: the Behavioral Analysis Unit, the Child Abduction Serial Murder Investigative Resources Center, and the Violent Criminal Apprehension Program.

For more information on the parent program and the three component offerings, please visit [National Center for the Analysis of Violent Crime](#).

The National Sexual Assault Kit Initiative Training and Technical Assistance Program

The SAKI Training and Technical Assistance (TTA) program, led by RTI International, offers expertise and assistance to jurisdictions as they establish best practices for the collection and processing of forensic evidence, the investigation and prosecution of sexual assault cases resulting from evidence from previously unsubmitted sexual assault kits, and support of survivors of sexual assault. The SAKI TTA team assists in the development, implementation, and dissemination of best practices, policies, and protocols for addressing issues resulting in and leading to large numbers of unsubmitted sexual assault kits, and how to prevent these issues from reoccurring.

RESOURCES FOR AGENCIES PURSUING COLD CASE INVESTIGATIONS *(continued)*

For more information regarding the SAKI TTA program and training dissemination offerings, please visit [Sexual Assault Kit Initiative Training and Technical Assistance](#).

Project: Cold Case

This not-for-profit organization was formed to provide hope to families of unsolved homicide victims in cold cases that do not present favorable evidence. This organization publicized unsolved homicides in the United States while linking information, families, and law enforcement with the goal of shedding light and ultimately solving cold case homicides.

For more information on this organization, or to submit a case to be publicized, please visit [Project: Cold Case](#).

ACTIVITY ANSWERS AND REASONINGS

CHAPTER 1

◆ Question 1

- **Correct Answer: B.** Background DNA.
- **Reasoning:** DNA was transferred from the **sales associate** to the handbag during the transaction. The **sales associate's** DNA is considered **background DNA**, as it was transferred to the item **before** the crime occurred.

◆ Question 2

- **Correct Answer: C.** Touch Deposit.
- **Reasoning:** DNA was transferred from **Person B** to the handbag **during** the mugging attempt. DNA transferred **during** the commission of a crime is referred to as a **touch deposit**.

◆ Question 3

- **Correct Answer: A.** Contamination.
- **Reasoning:** DNA was transferred from **Detective A** to the handbag **after** the crime had been committed. DNA deposited on an item **after** the crime is referred to as a **contamination** event.

◆ Question 4

- **Correct Answer: G.** All of the above.
- **Reasoning:** All four individuals' DNA has the potential of being detected as a DNA profile after the handbag is processed for touch DNA. **Person A** may be present as a victim profile; the **sales associate** may be present as a background profile; **Person B**, the perpetrator, left a touch deposit while attempting to mug the victim and may be present as a perpetrator profile; and **Detective A** handled the evidence without gloves and may be present as a contamination profile. All four individuals interacted with the handbag in some way during various times, thus, all four have an equal possibility of being detected during analysis of the handbag.

CHAPTER 2

◆ Question 1

- **Correct Answer: Option 1** would provide a more-suitable item of evidence to be processed for touch DNA.
- **Reasoning:** The perpetrator in Option 1 suffers from a medical condition that is known to cause flakiness of the skin. As such, it can be assumed that this individual would be more likely to be classified as a **"shedder"** than an individual who is constantly washing their hands.

◆ Question 2

- **Correct Answer: Option 2** would provide a more-suitable item of evidence to be processed for touch DNA.
- **Reasoning:** Even though the rod in Option 1 was handled for a longer **duration** of time, because the perpetrator was handling the rod while **ungloved** in Option 2, this would provide a better opportunity to obtain touch DNA.

ACTIVITY ANSWERS AND REASONINGS *(continued)*

♦ Question 3

- **Correct Answer: Option 2** would provide a more-suitable item of evidence to be processed for touch DNA.
- **Reasoning:** Consider the **size** of the item (the large piece of a torn shirt in this case is larger than the small concrete rock), the **duration** the item was handled (the shirt was worn, whereas the rock was handled for a short duration before being thrown), and the **surface type** (the shirt has a porous surface and may be more likely to lead to a result than the concrete which has a semi-porous surface).

♦ Question 4

- **Correct Answer: Option 2** would provide a more-suitable item of evidence to be processed for touch DNA.
- **Reasoning:** A nonwindowed warehouse would ensure the item is kept out of direct sunlight, as this can **degrade** the possible touch DNA on the item. Additionally, storage of the dried T-shirt at room temperature can also protect against possible touch DNA **degradation**, leading to a higher likelihood of obtaining a perpetrator profile.

CHAPTER 3

♦ Question 1

- **Correct Answer: A.** Wearer; Handler
- **Reasoning:** The **wearer** is defined as the habitual user of an item, whereas the **handler** is defined as the individual who handled the item during the crime. In this case, the **victim** would be the **wearer** because they are the owner and typical user of the shoelaces. The **suspect** would therefore be the **handler** because they used the shoelaces during the crime.

♦ Question 2

- **Correct Answer: B.** Handler
- **Reasoning:** Cartridge casings, weapon handles, and condom wrappers are frequently utilized or **handled** during a crime. Remember, the **handler** is defined as the individual utilizing the item during the crime.

♦ Question 3

- **Correct answer: B.** Handler; Wearer
- **Reasoning:** The **victim** would be the **handler** in this case because they are the individual who pulled off the **suspect's** mask during the crime. The **suspect** would therefore be the **wearer** because they are the owner and typical user of the mask.

♦ Question 4

- **Correct Answer: A.** Wearer
- **Reasoning:** Clothing, eyeglasses, and gloves are all items that are worn instead of handled. Therefore, these items are worn by the habitual user, or owner, of the item. Depending on the situation or scenario of the case, these items could also be tested for **handler** DNA; however, this would focus on the outside of these items or areas that were known to be touched by the perpetrator.

ACTIVITY ANSWERS AND REASONINGS *(continued)*

CHAPTER 4

◆ Question 1

- Correct Answer: **B. FALSE**
- Reasoning: This is the definition of an **elimination sample**. Control samples (also known as blanks) are samples of a known source that were presumably uncontaminated during the crime and are used to filter out potential background noise in a resulting DNA profile.

◆ Question 2

- Correct Answer: **B. FALSE**
- Reasoning: It is best practice for forensic DNA laboratories to obtain **elimination samples** from laboratory personnel, law enforcement officers, crime scene investigators, cleaning staff, first responders, and any other individuals who may come in contact with items of evidence at any stage from collection at the scene through final disposition.

◆ Question 3

- Correct Answer: **A. TRUE**
- Reasoning: **Reference samples** (also known as standards) will help demonstrate relationships of individuals to the scene, other individuals involved, and objects located at the scene.

◆ Question 4

- Correct Answer: **B. FALSE**
- Reasoning: Mixtures can be composed of **two** or more donors. The more donors contributing to the mixture, the more complicated the analysis and interpretation of that mixture will be for the analyst, proving the importance of obtaining relevant reference, control, and elimination samples to prevent against false investigative leads and a waste of resources.

CHAPTER 5

◆ Question 1

- Correct Answer: **A. Yes**
- Reasoning: Two other evidence items belonging to the case can be used as a fallback in the case of unsuccessful results, and all involved parties have successfully signed the **Authorization for Consumption of DNA Sample Form**.

◆ Question 2

- Correct Answer: **B. A swab from the baseball bat**
- Reasoning: It is common practice for evidence containing biological fluid to be **half sampled**, and the other half to be preserved for future (re)testing. Thus, a cutting from the shorts containing a suspected bloodstain would not require full consumption. Opposite this, a swab from the baseball bat, which may contain touch DNA, would likely need to be fully consumed pending a signed **Authorization for Consumption of DNA Sample Form**.

◆ Question 3

- Correct Answer: **B. No**
- Reasoning: Even though there are various other items of evidence belonging to this case that could potentially be used as fallbacks, because there is no signed **Authorization for Consumption of DNA Sample Form**, the laboratory should not accept this item of evidence for touch DNA sampling and processing.

ACTIVITY ANSWERS AND REASONINGS *(continued)*

♦ Question 4

- **Correct Answer: A.** A cutting of the ligature.
- **Reasoning:** Although both of these evidence items would likely be candidates for touch DNA processing, only the ligature contains a signed **Authorization for Consumption of DNA Sample Form**. Without obtaining an **Authorization for Consumption of DNA Sample Form** for the ammunition, even though it is known to have been handled by the perpetrator, the laboratory would be unable to test this evidence sample.

CHAPTER 6 – ACTIVITY

♦ Question 1

- **Correct Answer: B.** Ensure all storage locations (on- and off-site) have been thoroughly searched.
- **Reasoning:** If evidence associated with a case cannot be located, it is important to **physically** check all possible storage locations, as the documentation referencing the original storage location may be outdated or incorrect. In addition, contacting any and all agencies involved alongside of your MDT, not just the original investigating personnel, may provide insight into the evidence's current physical location.

♦ Question 2

- **Correct Answer: E.** All of the above.
- **Reasoning: Any and all** documentation relating to a case's associated evidentiary items should be collected during the evidence review process. The more information that is collected during this review, the easier it will be to form investigative questions and a testing strategy to benefit closure of the case.

♦ Question 3

- **Correct Answer: A.** Advise on sample prioritization.
- **Reasoning:** It is imperative that a **laboratory representative** from your parent-agency laboratory or outsourcing laboratory be included on your MDT. This representative will be able to provide additional insight into developing a testing strategy, specifically regarding sample prioritization and planning, that will provide the greatest benefit to the case.

♦ Question 4

- **Correct Answer: C.** Review the casefile, identify all associated evidence, physically locate evidence, develop investigative questions, hold a consultation with your MDT, and develop testing strategy.
- **Reasoning:** The process of determining what to submit to the laboratory for DNA processing should be systematic and intentional. A review of the casefile will serve as a refreshing of the case and provide all accessible information and documentation associated with the case. Once this has been completed, all associated evidence can be identified through the relevant documentation. After establishing all evidence belonging to the case, the evidence needs to be physically located, as documentation can be outdated and not reflective of the current availability and location of the evidence. After all evidence is physically located, law enforcement can develop the outstanding investigative questions pertaining to the case and what questions they hope DNA testing can provide insight on. These questions and all associated

ACTIVITY ANSWERS AND REASONINGS *(continued)*

documentation gathered through the evidence review and physical location of the evidence should be brought to the MDT consultation. This consultation should consist of all relevant key players (e.g., laboratory representatives, victim advocates, law enforcement, prosecutors) and will serve as the conversation to develop a testing strategy. The developed testing strategy will be used to delineate the evidentiary items that are most likely to provide insight to outstanding investigative questions.

CHAPTER 6 – EVIDENCE REVIEW IN PRACTICE

♦ Question 1: Development of Investigative Questions

- While there is no correct or incorrect answer, the following investigative questions could lend insight into the case:
 1. Who is the suspect?
 2. Who is the victim?
 3. Can we place the victim in the POI's car?

♦ Question 2: Development of Testing Strategy

- While there is no correct or incorrect answer, here is how Investigator A and the other MDT members compiled their testing strategy:
 1. Submit the shirt worn by victim. The inside should be tested for wearer DNA in an attempt to develop a victim profile.
 2. If a victim profile was not developed, submit fingernail clippings in an attempt to develop victim profile. If a sufficient victim profile was developed from the shirt, test the fingernail clippings for suspect DNA.
 3. Submit the beer can in an attempt to develop a suspect profile.
 4. If a suspect profile cannot be developed from any item of evidence and if a victim profile is available for comparison, submit the cut piece of stained carpet from the trunk of the POI's car. The stain should be tested for victim DNA in an effort to place the victim in the POI's trunk.

References

1. Williamson, Angela. "Touch DNA: Forensic Collection and Application to Investigations." *The Journal of Association for Crime Scene Reconstruction* 18, no. 1 (2012): 1. <https://www.acsr.org/wp-content/uploads/2012/01/Williamson.pdf>
2. Galbincea, Pat. "Akron Man Sentenced to Life without Parole for 2009 Murder of a Mother and Her Son." *Cleveland.com*, last updated August 9, 2010. https://www.cleveland.com/metro/2010/08/akron_man_sentenced_to_life_wi.html
3. State of Ohio v. Johnnie D. Cook, No. 25573, 2011 Ohio 4391 (Ohio Ct. App. 2011). <https://casetext.com/case/state-v-cook-114>
4. Worth, Katie. "Framed for Murder by His Own DNA." PBS. April 19, 2018. <https://www.pbs.org/wgbh/frontline/article/framed-for-murder-by-his-own-dna/>
5. Smith, Peter Andrey. "When DNA Implicates the Innocent." *Scientific American*. June 1, 2016. <https://www.scientificamerican.com/article/when-DNA-implicates-the-innocent/>
6. Goray, Mariya, and Roland van Oorschot. "Shedder Status: Exploring Means of Determination." *Science & Justice* 61, no. 4 (2021): 391-400. <https://doi.org/10.1016/j.scijus.2021.03.004>
7. Ballou, Susan, Margaret C. Kline, Mark D. Stolorow, Melissa Taylor, Shannan Williams, Phylis S. Bamberger, Burney Yvette, Larry Brown, et al. "Packaging and Storing Biological Evidence." *In The Biological Preservation Handbook: Best Practices for Evidence Handlers* [NISTIR 7928], by Gaithersburg, MD: National Institute of Standards and Technology, 2013. https://www.nist.gov/publications/biological-evidence-preservation-handbook-best-practices-evidence-handlers?pub_id=913699
8. National Institute of Standards and Technology, Technical Working Group on Biological Evidence Preservation. *Biological Evidence Storage Conditions*. Gaithersburg, MD: National Institute of Standards and Technology, uploaded 2017. <https://www.nist.gov/system/files/documents/2017/05/09/bioEvHandbook-poster-rev-06.pdf>
9. M-Vac® Systems, Inc. *M-Vac Forensic DNA Collection System*. M-Vac® Systems, Inc., n.d. <https://www.m-vac.com/images/pdfs/m-vacsystemsflyer.pdf>
10. North Carolina Center on Actual Innocence. "Mark Carver, Conviction Overturned after 8 Years." North Carolina Center on Actual Innocence, accessed July 15, 2021. <https://www.nccai.org/mark-carver/>
11. Lee, Hank. "Motions Filed to Dismiss Charges against Mark Carver in 2008 Murder Case." WCNC Charlotte. November 3, 2021. <https://www.wcnc.com/article/news/crime/mark-carver-murder-conviction-charges-dismissed-ira-yarmolenko-case/275-16334ea1-d540-444a-9aba-ac222362af85>
12. Bieber, Frederick, John S. Buckleton, Bruce Budowle, John M. Butler, and Michael D. Coble. "Evaluation of Forensic DNA Mixture Evidence: Protocol for Evaluation, Interpretation, and Statistical Calculations Using the Combined Probability of Inclusion." *BMC Genetics* 17, no. 1 (2016): 125. <https://doi.org/10.1186/s12863-016-0429-7>
13. National Institute of Justice. "Glossary for Crime Scene Investigation: Guides for Law Enforcement." Topics. National Institute of Justice, September 3, 2009. <https://nij.ojp.gov/topics/articles/glossary-crime-scene-investigation-guides-law-enforcement>

References *(continued)*

14. Organization of Scientific Area Committees for Forensic Science (OSAC), Biology/DNA Scientific Area Committee, Biological Data Interpretation & Reporting Subcommittee. *Best Practice Recommendations for the Management and Use of Quality Assurance DNA Elimination Databases in Forensic DNA Analysis*. OSAC, 2019: 4. https://www.nist.gov/system/files/documents/2020/08/04/Best%20Practice%20Recommendations%20for%20the%20Management%20and%20Use%20of%20Quality%20Assurance%20DNA%20Elimination%20Databases%20in%20Forensic%20DNA%20Analysis_OSAC%20Proposed.pdf
15. Organization of Scientific Area Committees for Forensic Science (OSAC), Biology Scientific Area Committee, Human Forensic Biology Subcommittee. *Best Practice Recommendations for the Management and Use of Quality Assurance DNA Elimination Databases in Forensic DNA Analysis* [OSAC 2020-N-007]. Gaithersburg, MD: OSAC, 2021. https://www.nist.gov/system/files/documents/2021/04/01/OSAC%202020-N-0007_Best%20Practice%20Recommendations%20for%20the%20Management%20and%20Use%20of%20Quality%20Assurance%20DNA%20Elimination%20Databases%20in%20Forensic%20DNA%20Analysis_FINAL%20OSAC%20PROPOSED%20REG.pdf
16. National Sexual Assault Kit Initiative Training and Technical Assistance (SAKI TTA) Other Violent Cold Case Crimes (OVCCC). *Forensic Genetic Genealogy Laboratory Considerations and Technology Limitations*. SAKI TTA, 2022. <https://sakitta.org/ovccc/docs/14773OVCCCFGGLabLimitations.pdf>
17. Federal Bureau of Investigation (FBI). "Frequently Asked Questions on CODIS and NDIS." DNA Fingerprint Act of 2005 Expungement Policy. Washington, DC: Federal Bureau of Investigation, accessed July 15, 2021. <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet>

Appendix A: Elimination Database Sample Consent Form

1. Acquisition of Genetic Information, 29 C.F.R. § 1635.8(b)(6). 2008. Accessed through Cornell Law School Legal Information Institute. <https://www.law.cornell.edu/cfr/text/29/1635.8>
2. U.S. Equal Employment Opportunity Commission. "Fact Sheet: Genetic Information Nondiscrimination Act." Guidance. U.S. Equal Employment Opportunity Commission. Accessed July 15, 2021. <https://www.eeoc.gov/laws/guidance/fact-sheet-genetic-information-nondiscrimination-act>

Appendix B: Authorization for Consumption of DNA Sample Form

1. Crime Laboratory Division. *Authorization for Consumption of DNA Evidence* [3000-210-018]. Olympia, WA: Washington State Patrol, 2013.

Appendix F: Resources for Agencies Pursuing Cold Case Investigations

1. National Sexual Assault Kit Initiative (SAKI). "About the National Sexual Assault Kit Initiative." SAKI, accessed July 15, 2021. <https://sakitta.org/about/>
2. Project: Cold Case. "About." Project: Cold Case, accessed July 6, 2023. <https://projectcoldcase.org/about/>
3. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Assistance. "Emmett Till Cold Case Investigations and Prosecution Program." U.S. Department of Justice, last modified November 1, 2022. <https://bja.ojp.gov/program/emmett-till-cold-case-investigations-and-prosecution-program/overview>
4. U.S. Department of Justice, Office of Justice Programs, Bureau of Justice Assistance. "Prosecuting Cold Cases Using DNA." [Bureau of Justice Assistance] Home. U.S. Department of Justice, last modified June 14, 2022. <https://bja.ojp.gov/program/prosecuting-cold-cases-using-dna/overview>

References *(continued)*

5. U.S. Department of Justice, Civil Rights Division. "Cold Case Initiative." The United States Department of Justice, last updated November 21, 2021. <https://www.justice.gov/crt/cold-case-initiative>
6. Federal Bureau of Investigation (FBI). "Investigative Programs: Critical Incident Response Group." FBI. accessed July 15, 2021. <https://www2.fbi.gov/hq/isd/cirg/ncavc.htm#vicap>
7. National Sexual Assault Kit Initiative (SAKI). "SAKI Home." SAKI, accessed July 6, 2023. <https://sakitta.org/>

Appendix G: Activity Answers and Reasonings

1. National Institute of Justice. "Glossary for Crime Scene Investigation: Guides for Law Enforcement.," Topics. National Institute of Justice, September 3, 2009. <https://nij.ojp.gov/topics/articles/glossary-crime-scene-investigation-guides-law-enforcement>

