Forensic Biology (Serology & DNA) - Overview

The Forensic Biology discipline performs serological and DNA analyses of bodily fluids for the purpose of identification and individualization. The type of material typically examined includes, but is not limited to blood, semen, and saliva collected at crime scenes or from articles of physical evidence. These types of bodily fluids are frequently generated during the commission of violent crimes such as homicides, rapes, assaults, and hit and run fatalities. The ultimate goal is to identify what type of material is present and then, through the use of DNA analysis, link that material to a specific person.

The services of Forensic Biology are intended to assist the criminal justice system by providing timely scientific analysis of biological evidence. When appropriately utilized, this testing has the potential to supply unbiased information to:

- Link or eliminate a suspect with biological evidence
- Substantiate case circumstances
- Corroborate or refute an alibi
- Identify a weapon used

The forensic biologist begins by evaluating the investigative information and available evidence to understand the nature of the case and the forensic question(s) to be answered. Initially, items of physical evidence are examined for blood, semen, or saliva. Further analysis is guided by the investigating officer's request, case circumstances, sample size and condition, available technology, and/or conformance to case policy.

Classification of biological evidence by conventional serology methods (ABO and polymorphic enzyme groupings) is no longer performed. DNA technology is used for individualization of biological evidence in forensic casework. Although biological evidence can be associated with an individual, it is not possible to determine the age of the sample.

Another service of Forensic Biology is the development of a Georgia DNA database of convicted felons and felony probationers as authorized by O.C.G.A. 35. This database allows for the comparison of DNA profiles from casework samples to those offenders in the Georgia file. Profiles are also periodically uploaded to a national database as well. This database utilizes a FBI program known as CODIS (Combined DNA Index System). Routine searches are performed of the Georgia database as well as at the national

level. This is discussed in more detail under the "CODIS" section of this document.

Cases submitted with no known suspect will be tested and appropriate data entered into the CODIS system. It should be noted although DNA testing is performed on such cases, priority is given to those cases in which a suspect is listed.

The following is an overview of the functioning and criteria used by the Forensic Biology scientists in the examination and testing of evidence.

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Testing Times

The completion time for serological testing is highly variable and dependent on number and types of evidence items. The examination time for a single item is estimated below:

- Human blood – several hours to overnight
- Semen – several hours to overnight
- Spermatozoa (sperm) – several hours to overnight
- Saliva – hours

The longer time is usually needed when initial examinations are negative and require more extensive testing. Examination of multiple items will also increase these times significantly.

DNA analysis has a designated protocol which cannot be "rushed". The documentation and attention required by the procedures are essential to its success. Testing typically takes two to three weeks. Refer to "Collection and Submission of Known Samples" for these requirements.

Blood Examination

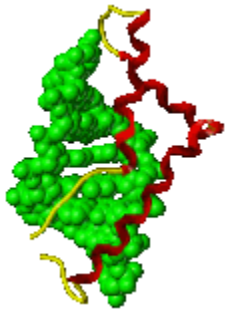
When adequate known blood from victim and/or suspect is submitted and reasonable justification accompanies the service request, evidence will be examined to:

- Locate bloodstain(s)
- Identify blood by chemical testing
- Determine if of human origin (this is not done if sample is to be DNA tested)
- Perform DNA testing

DNA testing on bloodstains from a victim's clothing or from under the body will not be performed when there is no question as to the blood's source. For the same reason, DNA testing on multiple bloodstains collected from a crime scene will not be performed unless there is justifiable reason to expect that the suspect is bleeding. The fewest possible number of samples will be

examined to answer the question at hand. Weapons removed from a wound by medical or autopsy personnel will not be routinely examined for blood.

Male DNA Screening



Semen analysis has consistently been one of the most requested services the forensic biology discipline receives. The evidence related to these requests is typically sexual assault collection kits involving female victims. The traditional analysis is time consuming and in some cases requires a scientist several days to complete just one case. Due to the volume of requests and analysis time, historically sexual assault kits are a large part of the discipline's backlog. To improve the backlog situation and turnaround time, a procedure was implemented in 2006, allowing high-throughput, quality testing of sexual assault kits. This procedure tests for the presence of male (Y) DNA. The statements on these reports only indicate the presence or absence of male (Y) DNA. The results of this testing do not produce a 'DNA profile' for comparison purposes. Since this testing is for male (Y) DNA, the traditional method will be retained for use on cases involving male victims.

Saliva Analysis

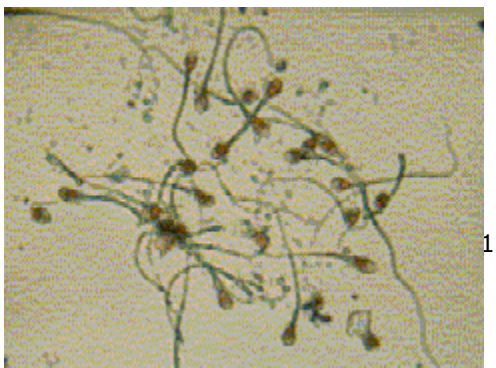
When dried stains or questioned samples are submitted, the evidence items will be examined to:

- Locate stain(s) using alternate light source
- Identify amylase (a chemical component of saliva)
- Evaluate suitability of evidence for DNA analysis
- Perform DNA typing when requested

When cigarette butts are submitted for saliva testing, the investigator must identify the brand(s) smoked by the victim, suspect, or other participants and confirm the last cleaning time of the location where collected. The examination for saliva and/or DNA typing will not be initiated until this information is provided to the analyst.

Semen Identification

When evidence is submitted in a sexual assault case with a suspect identified, the evidence will be examined as appropriate to:



- Locate the semen stain(s) visually or by alternate light source
- Perform chemical tests for seminal fluid
- Examine microscopically for spermatozoa (sperm)
- Test for other semen components when negative for sperm
- Perform DNA typing when requested

(NOTE: Liquid semen is not needed as a known sample.)

When a sexual assault evidence kit is submitted with no suspect identified, the items will be examined for semen. DNA analysis will be performed on cases that are positive for sperm or male DNA testing. The male DNA fraction from sexual assault cases will be entered into CODIS for comparison with other cases as long as the sample meets FBI requirements for eligibility.

Sexual assault evidence collection kits are examined as initial priority. Victim's clothing and bed linen will **not** be routinely examined for semen. An investigator may request this service by providing information which warrants the examination or indicates the likelihood that semen would be found on the clothing or bed linen when not present in swabbings from the victim's body or a sexual assault kit was not taken. Proper collection of victim's clothing remains important, however, because it can be needed for DNA analysis in some circumstances.

Semen identification is not performed on suspect's clothing or bed linen.

Combined DNA Index System (CODIS)

CODIS is a FBI managed database of DNA profiles. These profiles include casework and convicted offenders. Each state that contributes data to CODIS has its own definition of who is a convicted offender. The casework database is composed of "forensic unknowns", which is predominately sperm DNA profiles from sexual assault cases and blood profiles from homicide, burglary, and assault cases. The FBI provides the software. Approved states may upload their profiles to the National Database to be searched against the database profiles from other states.

CODIS does not allow the users to upload profiles of victims, suspects, and elimination blood samples (e.g. DNA profiles of consensual partners in sexual assault investigations).

Any DNA recovered from evidence submitted to the GBI that did not originate from the victim or elimination person and meet eligibility requirements is uploaded and searched in CODIS. If a potential match occurs (hit) between cases, the agency representatives involved will be notified and advised of any needed action on their part. If a hit is made with a convicted felon, the officer will be notified to submit a new known sample of the convicted felon for confirmation. All DNA profiles in CODIS are continuously searched against all new profiles added; therefore, there is no need to request a routine search in CODIS.

DNA Typing

The FORENSIC BIOLOGY discipline continues to maintain its cutting-edge position in DNA technological advancements.

DNA typing can be used as an investigative or trial tool to:

- Identify the donor of biological evidence
- Exclude a falsely accused suspect
- Associate serial rapes or other series of similar crimes
- Distinguish multiple assailants in rape cases
- Determine victim identity when other identification is not available
- Determine parentage in **criminal** cases only (it is recommended to call the forensic biology manager to discuss this service prior to submission of samples.)

DNA testing may be performed on hair if specific criteria are met. If any other probative forensic results are available, DNA testing on hair will **not** be performed. For questions regarding this service call the forensic biology manager for further information.

A forensic biologist prepares a capillary electrophoresis (CE) instrument for use. The state-of-the-art CE assigns DNA to samples and then charts the findings on to a computer. Scientists review the results to determine whether the profile matches that of the suspect or victim.

Over the years, the court challenges to the use of DNA technology have moved from the contention that the technology itself is somehow scientifically improper to attacks on the way the statistics are analyzed. The GBI Crime Lab has and will continue to interpret the statistics in a conservative and responsible manner.

Other Specialized Examinations

Tissue (skin, muscle, etc.), or other body parts are identified in conjunction with the DOFS Pathology Section for testing in some instances. Further individualization procedures are dependent on the nature and condition of the evidentiary material.

Bone

GBI can perform DNA testing on bone that is relatively fresh. Specifically bone that still contains marrow. Older, dried bone must be sent to outside laboratories for testing.

'Last Resort Testing'

This category of evidence is not routinely tested and requires prior approval.

Fingernails: in most instances the DNA profile is consistent with the individual the nails are taken from. Obvious investigative information must be available supporting the potential for biological material being present (victim or subject injured via scratching of nails, etc.)

Contact or 'Touch' DNA: this type of DNA test has been overly dramaticized in the entertainment industry. This category involves DNA transferred from a person to an item by that person having been in contact with that item. Although the DNA tests used today are more sensitive and require less sample, a certain amount of DNA is still required to obtain a reliable, reproducible result. A single 'touch', leaning or 'sweating' on something does **not** leave sufficient cells (DNA) to test.

GBI will perform this type of test on **violent crimes only and with prior approval from management.**

Health and Safety Considerations

The Universal Precaution is that all biological evidence (liquid or dried) must be considered as a potentially infectious biohazard. For this reason, adequate protective clothing and proper evidence handling techniques are essential. Disposable latex gloves should always be worn when collecting and packaging evidence with possible body fluid stains. Gloves serve the dual purpose of protecting oneself from contact with potentially infectious pathogens and when appropriately changed, preventing cross-contamination of biological stains from one item to another. Masks are recommended as well due to the sensitive nature of DNA testing and the possibility of contamination by the collector.

Evidence Submissions

Collection and Submission of Known Samples

DNA has the potential to identify or eliminate a person as the source of biological evidence. Known reference samples (see below) may be in the form of liquid blood or buccal swabbings (preferred). If other individuals are suspected to be involved in a crime, their known samples should be submitted when relevant. In sexual assault cases, if recent voluntary sex (within 72 hours) is indicated, a known sample from the consenting partner is also necessary. Convicted samples *collected* in prison for purposes of the DNA database or CODIS are **not** considered known samples and will not be substituted as such.

Liquid Blood Samples

NOTE: Collect approximately 5 ml known blood in a purple-stoppered tube containing EDTA.

The blood tube(s) should be adequately labeled prior to delivery to the DOFS laboratory with the full name of the person from whom the blood was collected, the date and time of collection, the name (or initials) of the person obtaining sample, and, when applicable, the name (or initials) of the investigator observing the collection. The tube(s) should be individually sealed and enclosed in packaging that is also sealed. Marking the outer package "Knowns for DNA" will ensure proper routing in the DOFS laboratory.

Blood samples should be forwarded to the laboratory at the earliest possible time following collection. When necessary, blood can be held refrigerated prior to transfer but must not be frozen. It is preferable that blood is delivered in person during working hours but can be mailed/shipped using priority delivery. The samples should be sent early in the week so that their arrival is not delayed by a weekend. **Liquid blood samples must not be enclosed in the same package with other physical evidence.**

Knowledge of a blood transfusion prior to collection of a known blood should be relayed to the analyst in written documentation accompanying the sample. If a person has received multiple blood transfusions, contact the assigned analyst prior to collection of a known sample. In this instance, it may be necessary to wait 90 to 120 days before collecting the known blood.

Bandages or other samples collected from a wound are <u>not</u> suitable for use as a known. Bloodstained clothing will be used only when the individual is deceased and adequate known blood sample cannot be obtained. However, if this clothing is unsuitable, tissue or other appropriate samples should be collected at autopsy as described later.

Buccal Swabs (preferred)

Buccal swabbings are taken from the mouth and may also be collected for use as a known sample in DNA analysis. Commercial kits may be purchased

by private vendors if so desired. Instructions for collection of buccal swabbings is contained in such kits and do not require special medical personnel. **NOTE: Do not collect a liquid saliva sample. Gum, cigarette butts or drink containers are also not to be collected as known reference items.**

Tissue and other Biological Samples from Autopsy

Samples collected at autopsy for use as knowns are dependent on the condition of the deceased. Blood or bloodstain cards are preferred but if unsuitable or unavailable, tissues (including fingernails) or other biological samples may be submitted. Closely clipped fingernails are the preferred sample for DNA analysis when a body is decomposed. Because certain tissues are unsuitable, it is recommended that the Forensic Biology manager be contacted regarding the best-known sample source for analysis. These submissions must be adequately labeled with the sample type in addition to other identifying information. **Samples preserved in formaldehyde (formalin) are unsuitable for DNA.** Tissues should be frozen immediately to best preserve sample quality and transported to the DOFS laboratory on ice or priority shipped on dry ice.

Physical Evidence

When collecting physical evidence, it is preferable that the entire object be submitted to the laboratory with questioned stains intact. If removal or transport of an item is not possible, the stain(s) may be cut out or, when necessary, scraped from the item. Small stains should be collected on a water-dampened cotton-tipped applicator that must be air dried prior to packaging. Due to the sensitive nature of DNA testing, care must be taken not to contaminate the sample by the individual collecting the sample. This includes wearing gloves, masks and refrain from sneezing or coughing on the sample.

Physical evidence for serological and DNA analysis should be packaged in paper, paper bags, envelopes, or cardboard boxes as appropriate to the sample type. For example, blood scrapings should be enclosed in folded paper packets, which are capable of containing the evidence without loss. Envelopes, paper bags, and pillboxes do not provide a suitable enclosure because scrapings can leak out at seams or openings. Tape is also an unsuitable method to retain scrapings. **Plastic bags and airtight containers are unacceptable because they create an environment that can be damaging to biological evidence.** Because heat, humidity, and sunlight all have destructive effects, evidence packages should always be maintained in a cool, dry location following collection.

Items from separate sources (victim and suspect clothing) or those suspected to have stains from different donors should always be **packaged separately**. These should not be handled excessively – especially in stained areas. All evidence items must be completely dried without heat or sunlight before packaging for delivery. Items with wet stains should be spread out on clear paper to dry because if they are folded wet, multiple stains can be created from one stain. Air-drying should be accomplished in a manner,

which prevents cross-contamination of stains and loss of other evidence types (hair, fibers, or other trace evidence). Proper drying is particularly important to minimize the degradation of DNA.

Sexual Assault Evidence Collection Kits

The GBI Sexual Assault Evidence Collection Kit is prepared commercially. These kits have been adapted to comply with the statewide medical examination protocol developed for sexual assault victims. The kit is sufficient to collect adequate samples from the victim's body to perform semen or male DNA testing. The instruction sheet provided in each kit is explicit and complete for proper evidence collection. Inadequate collection and/or preservation of these samples can eliminate the potential for suspect identification. No tubes are provided to obtain a known blood sample from the victim during the medical examination. In 2003 these kits were produced to include envelopes and swabs to collect buccal swabs as a known reference sample. If blood samples are taken, they should **not** be placed inside the sexual assault kit itself and should be packaged separately as described above.