



THE FBI's DNA & DATABASING INITIATIVES

Nuclear DNA Analysis
Mitochondrial DNA Analysis
CODIS

DNA

THE FBI and DNA

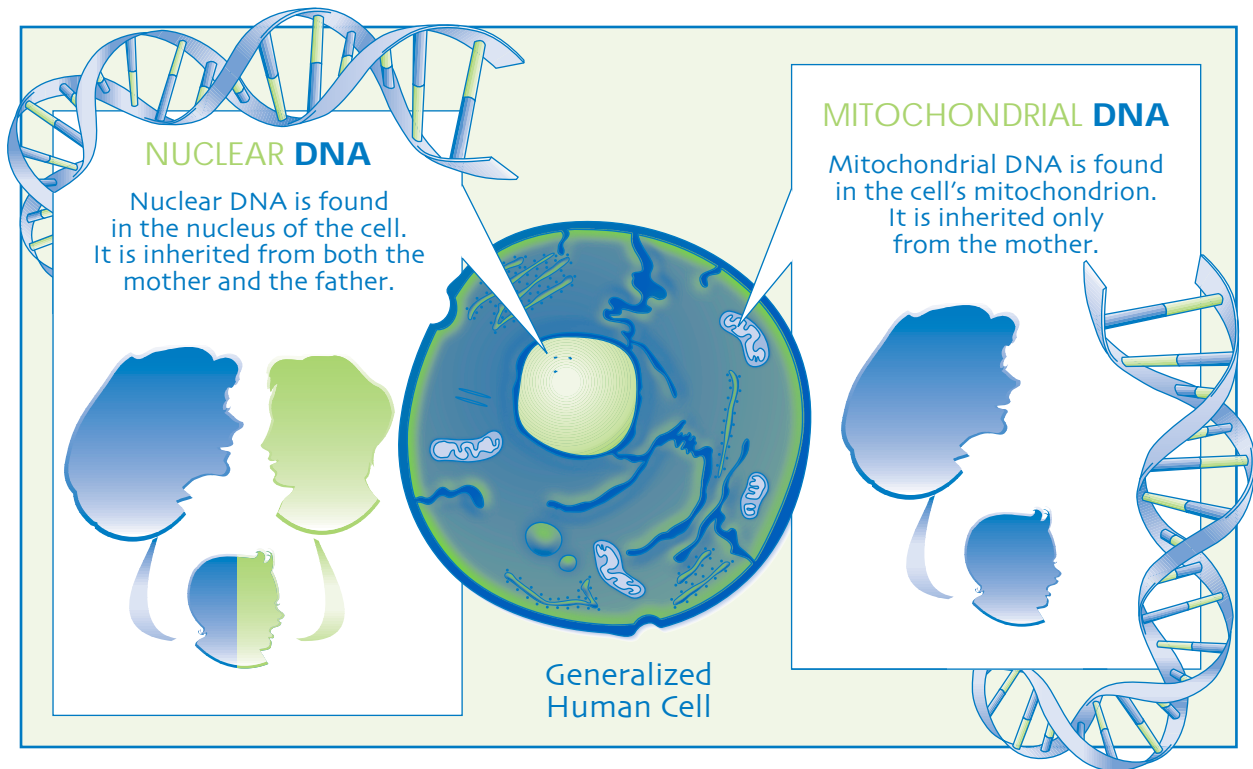
The FBI Laboratory is one of the largest and most comprehensive forensic laboratories in the world, and is the only full-service Federal forensic laboratory. The FBI Laboratory examines evidence free-of-charge for Federal, state, and local law enforcement agencies and provides expert witness testimony regarding the results of forensic examinations. Several sections, organized into specialized units, provide assistance with the collection, preservation, and analysis of evidence from crime scene investigations. In support of the overall mission of the Laboratory, the DNA Analysis Unit I, DNA Analysis Unit II, and the Forensic Science Systems Unit have a DNA and Databasing Initiative.

The **DNA Analysis Unit I** provides serological and nuclear DNA testing services to all Federal agencies, United States Attorneys, military tribunals, duly constituted state, county, and municipal law enforcement agencies in the United States, or Territories of the United States, in conjunction with criminal investigative matters and provides expert witness testimony in criminal judicial proceedings on both a national and international level. The **DNA Analysis Unit II** is responsible for three major programs: mitochondrial DNA case-work, missing persons, and the Federal Convicted Offender Program. The **COMBINED DNA INDEX SYSTEM** (CODIS) blends forensic science and computer technology into an effective tool for solving violent crimes. CODIS enables Federal, state, and local crime laboratories to exchange and compare DNA profiles electronically, thereby linking crimes to each other and to convicted offenders.

NUCLEAR DNA

The DNA Analysis Unit I (DNAUI) examines evidence from crime scenes to determine if biological material, such as blood and semen, is present. If present, the material is subjected to DNA testing. In addition to these common stains, DNA profiles can be obtained from a variety of other samples as well. For example, cigarette butts, postage stamps, hat bands, shirt collars, and other items that have been in close contact with an individual can often yield a genetic profile.

Traditionally, DNA was analyzed using RFLP (restriction fragment length polymorphism) technology. This form of DNA typing used large fragments of DNA that were separated by size. Although highly informative, many forensic samples were too small or degraded to be analyzed.



The advent of PCR (polymerase chain reaction) allowed for the analysis of small or degraded samples by making copies of the original sample. Currently, the DNAUI and most of the forensic community use the PCR process to analyze regions of DNA called STRs (short tandem repeats). This typing procedure has the ability to analyze small degraded samples and provide a high level of information. Often, the source of an evidence sample can be determined.

DNAUI AND CODIS

The DNAUI's CODIS program captures relevant profiles from current cases and gathers probative data from old cases to be uploaded into the national database for comparisons with other participating CODIS laboratories. Additionally, the DNAUI is maintaining RFLP capabilities for samples that need to be compared to old cases that were analyzed with the RFLP method. This comprehensive approach to CODIS entries provides the database with quality information that can be used to assist many criminal investigations.

SUCCESS STORY

July 1999: The FBI Laboratory's DNA Analysis Unit I through its Unknown Subject Sexual Assault

Program with the Washington, D.C. Police Department received ten sexual assault cases that the National DNA Index System matched to three sexual assaults in Jacksonville, FL. The Jacksonville cases occurred in March, April and September of 1998. CODIS had previously linked the Jacksonville cases to one another in May 1999. DNA evidence was crucial in these three cases because none of the victims were able to describe the offender and no other physical evidence was left at the crime scenes. Five of the ten Washington, D.C. cases had already been linked together using CODIS before the national hit with Florida. The other D.C. cases were identified at later dates. In early July 1999, Leon Dundas, who is now deceased, was identified through DNA analysis as the perpetrator of the thirteen assaults.

MITOCHONDRIAL DNA

The DNA Analysis Unit II examines biological items of evidence from crime scenes to determine the mitochondrial DNA sequence from hair, bone, teeth, blood, or other tissues. Typically, these items contain low concentrations of degraded DNA, making them unsuitable for nuclear DNA examinations. The high sensitivity

of the mitochondrial DNA analysis allows the FBI Laboratory to obtain information from old items of evidence associated with cold cases and small pieces of evidence containing little biological material. Additionally, the maternal inheritance of mitochondrial DNA allows scientists to compare the mitochondrial DNA profile of a set of remains to that of reference samples from individuals such as the mother, brother(s), sister(s), or any other maternally related individuals of a missing person. These samples should have the same mitochondrial DNA profiles because all maternal relatives inherit the same mitochondrial DNA. Because mitochondrial DNA is maternally inherited and multiple individuals can have the same mitochondrial DNA type, positive identifications are not possible using mitochondrial DNA analysis. However, mitochondrial DNA is an excellent technique to use for obtaining valuable information in cases where nuclear DNA analysis is not feasible.

NATIONAL MISSING PERSONS DNA DATABASE PROGRAM

The National Missing Persons DNA Database Program was initially outlined in 1996 and was funded by Congress in 1999. This program will facilitate the collection and mitochondrial DNA typing of reference samples from maternal relatives of missing persons which will be placed in a database managed by CODIS. Additionally, this program will determine the mitochondrial DNA types of skeletal remains in an attempt to associate those remains to missing persons. Research is currently underway to validate state of the art procedures for managing and typing the large number of samples expected for this program. Case acceptance should begin in early 2001.

FEDERAL CONVICTED OFFENDER PROGRAM

The Federal Convicted Offender (FCO) Program will use nuclear DNA profiling techniques to type known samples from convicted felons in the Federal system and enter these profiles into the CODIS system, much like the state and local offender sample data already being entered by other CODIS laboratories. These profiles will be available for searches against any forensic database sample in the CODIS system. Funding for this program is expected by the beginning of the year 2001.

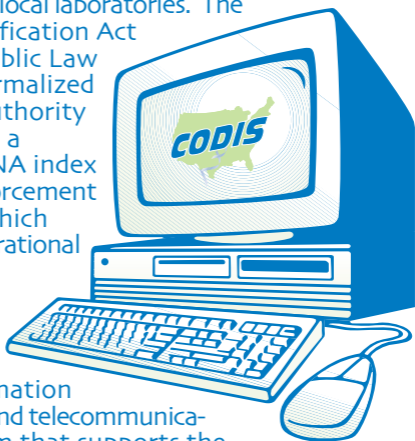
SUCCESSSTORY

May 1998: A set of remains was discovered in New Hampshire by a pair of joggers on an old logging road. Personal effects were found near the body, including a credit card from a 29 year-old woman who had disappeared in July 1969, but the medical examiner was unable to positively identify the woman based on the evidence recovered. The remains were sent to the FBI Laboratory's DNA Unit II for mitochondrial DNA analysis in October 1999. The mitochondrial DNA sequence for the unidentified remains was compared to the mitochondrial DNA sequence for a blood sample from a maternal relative of the missing woman. These two mitochondrial DNA types were found to be the same and were searched in the mitochondrial DNA population database. The sequence was not seen in any of the 4,142 samples in the database, which provided information as to the significance of the mitochondrial DNA results. Mitochondrial DNA was pivotal in the investigation to help identify the remains from this cold case.

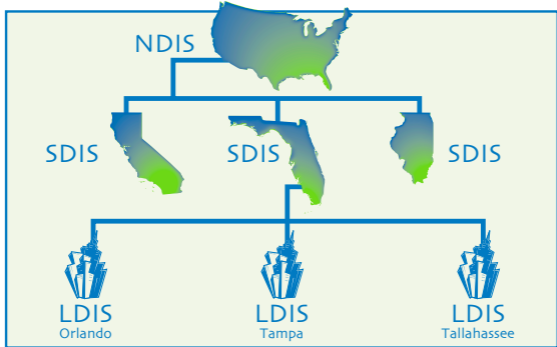
CODIS

The FBI Laboratory's **CO**mbined **DNA** Index **S**ystem (CODIS) began as a pilot project in 1990 serving 14 state and local laboratories. The DNA Identification Act of 1994 (Public Law 103 322) formalized the FBI's authority to establish a national DNA index for law enforcement purposes which became operational in 1998.

CODIS is an automated DNA information processing and telecommunications system that supports the National DNA Index System (NDIS), State DNA Index System (SDIS), and Local DNA Index System (LDIS). NDIS is the highest level in the CODIS hierarchy, and enables the laboratories participating in the CODIS Program to exchange and compare DNA profiles on a national level. All DNA profiles originate at LDIS, then flow to SDIS and NDIS. SDIS allows laboratories within states to exchange DNA profiles. The tiered approach allows state and local agencies to operate their databases according to their specific legislative or legal requirements.



CODIS ARCHITECTURE



The FBI provides CODIS software, together with installation, training, and user support, free of charge to any state and local law enforcement labs performing DNA analysis. Today, CODIS is installed in more than 100 laboratories. NDIS already contains more than 370,000 profiles from 30 states, the US Army and the FBI. In addition, the complete coverage of State DNA database laws occurred in 1998 with all 50 states having enacted legislation. This legislation requires persons convicted of felony sex offenses (and other crimes, depending on each state's statute) to provide biological samples for DNA analysis. These samples are analyzed and entered into the CODIS database. The FBI hopes that eventually, all 50 states will include all felony offenses.

INDEXES

CODIS generates investigative leads in crimes where biological evidence is recovered from the crime scene using two indexes: the Forensic and Offender Indexes.



The **Forensic Index** contains DNA profiles from crime scene evidence.



The **Offender Index** contains DNA profiles of individuals convicted of sex offenses (and other violent crimes) with many states now expanding legislation to include other felonies.

Matches made among profiles in the Forensic Index can link crime scenes together; possibly identifying serial offenders. Based on a match, police in multiple jurisdictions can coordinate their respective investigations, and share the

leads they developed independently. Matches made between the Forensic and Offender Indexes provide investigators with the identity of the perpetrator(s). After CODIS identifies a potential match, qualified DNA analysts in the laboratories responsible for the matching profiles contact each other to validate or refute the match.

THE FUTURE

There has been a sharp increase in the demand for CODIS services due to two factors – (1) advances in the technologies supporting human genome research and (2) increased awareness of the crime reduction potential of forensic DNA by executive and legislative bodies at the State, Local, and National levels, as well as by the general public. In fact, many law enforcement officials consider forensic DNA analysis the most significant advance in forensic science since fingerprints. As a result, states are rapidly expanding the scope and size of their CODIS databases.

Over the past five years about one-half of the states have expanded the scope of their original DNA database legislation (e.g., six states are including all felons in their database, in the past year about five states have expanded the scope of their legislation, and one state now covers all arrested persons). There is currently a backlog of over 500,000 convicted offender samples to be analyzed simply because a majority of states' analyses efforts are unable to keep pace with the collection of these samples. Plus, many labs are doing retests using the new STR technology. The FBI Laboratory is committed to building an infrastructure throughout the U.S. to support the CODIS program and will continue to work with state and local forensic laboratories to achieve the full potential of this investigative tool.

TRAINING OPPORTUNITIES

In addition to assisting forensic investigations, the DNA Analysis Unit I, DNA Analysis Unit II and CODIS program, along with the FBI Laboratory's Research and Training Units, provide specialized training in DNA testing methods to forensic scientists from state, municipal, and international crime laboratories. The staff of the FBI Laboratory often provides instruction to the legal and law enforcement communities (attorneys, judges, police officers, and crime lab personnel) on the fundamentals, improvements, and current research in the field of DNA and databasing. Further, the FBI sponsors and participates in national and international symposia and seminars devoted to topics surrounding DNA testing and databasing.



SUCCESS STORIES

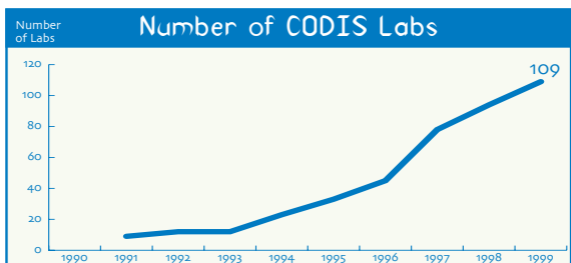
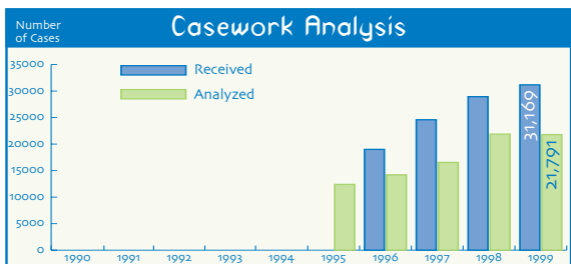
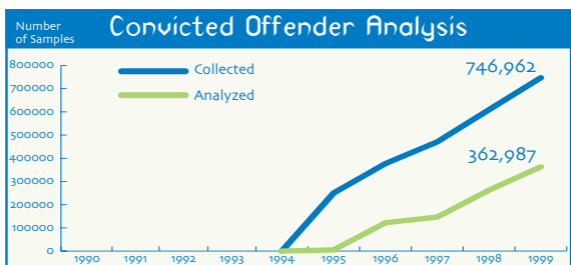
NEVADA;

May 2000: The Reno, Nevada Police Department made an arrest on a 23 year-old kidnaping/murder of a 6 year-old girl on Wednesday, May 31, 2000, based upon the first database hit in the Nevada State DNA database. The arrest was the culmination of extensive cooperation between local law enforcement and the FBI. On September 3, 1977, 6 year-old Lisa Marie Bonham was reported missing from Idlewild Park, Reno, where she was visiting with family members. The next day her clothing was discovered in a brown paper bag in a dumpster in Verdi, Nevada, a few miles from Reno. The clothing was submitted to the FBI Laboratory for examination and semen stains with Type A Secretor status were identified on portions of the clothing. On November 13, 1977, part of the victim's remains were recovered in Toiyabe National Forest, three miles from the Nevada border in Sierra County, California. On May 25, 2000, the Washoe County Sheriff's Crime Laboratory, the location of the Nevada State DNA Database (which utilizes CODIS software), matched the identified DNA from the victim's clothing with the known DNA of the subject Stephen Robert Smith.

FLORIDA & IOWA;

February 2000: In 1995, an unidentified woman's body was found on an off-ramp along an interstate in Des Moines, IA. After identifying the victim, police began looking at truck drivers as suspects, due to the location of the body. The Iowa Department of Public Safety sent biological evidence left at the crime scene to the FBI Laboratory for DNA analysis. The FBI Lab analyzed the evidence, and developed a DNA profile of the perpetrator. The profile was uploaded to CODIS, where NDIS matched it to the Florida offender. At the time of the hit, the offender was incarcerated in a Florida prison for a sexual assault conviction in early 1999. After identifying the offender, police discovered that he possessed a commercial trucking license.

DNA STATISTICS



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