

Crime Laboratory Division

The Missouri State Highway Patrol Crime Laboratory opened in May 1936, in Jefferson City, only five years after the inception of the agency itself. Very early in the history of the Patrol, forensic science was recognized as an essential element of the criminal investigation process. The Patrol's laboratory was one of the first crime laboratories in the country. The lab was first located in two rooms within the Broadway State Office Building. In 1963, the laboratory moved into 4,000 square feet of space in the basement of the new General Headquarters building on Elm Street in Jefferson City. It moved again in October 1979, this time into 11,000 square feet of the Annex Building, on the General Headquarters campus. Over the years the General Headquarters lab has acquired additional space within the annex building and has added on to the building, expanding the size of the lab.

The facility at GHQ was originally constructed to accommodate a staff of 15 personnel and an annual caseload of 2,500 cases. Today, the lab houses 56 criminalists and technicians with an annual caseload of over 10,000 cases and 14,000 CODIS samples. Over the years, the laboratory has expanded into a system of strategically located crime labs by the addition of seven satellite laboratories in Macon, St. Joseph, Park Hills, Cape Girardeau, Willow Springs, Springfield, and Carthage and has an annual caseload of 30,000 cases.

The Crime Laboratory Division is accredited by the ANSI National Accreditation Board. It was first accredited in 1984, and was the 23rd laboratory in the nation to earn this distinction. The accreditation community has since changed their focus toward international accrediting criteria commonly referred to as ISO accreditation. The Crime Laboratory Division achieved this international accredited status in 2011. The accreditation process now involves internal annual reviews, biennial external DNA audits, annual focused surveillance visits by the accrediting authority and a comprehensive external inspection of the entire laboratory operation every four years by ANAB assessors. The purpose of the accreditation process is to demonstrate the laboratory is complying with required accreditation standards and criteria, thus ensuring that the examinations are being conducted by qualified examiners within a highly functional quality management system.

The General Headquarters Laboratory

At the start of its operation, the Patrol Crime Laboratory was manned by uniformed officers of the Patrol. This continued until the first two civilian chemists were hired in 1962. The first chemist hired, Afton Ware, preceded Frank Durham, the second chemist hired, by only one month. For the first 20 years, the chemists were "generalists." They performed blood alcohol, chemical, drug, microscopic, and trace evidence testing. Other non-chemistry analyses such as firearms functioning, toolmarks, and fingerprints were still analyzed by trained uniformed officers at that time.

"Essentially, it was on-the-job training. Afton and I visited the St. Louis City Lab and the St. Louis County Coroner's Lab. They gave us some of their procedures. And,

we had books in the laboratory library that helped us," said retired Criminalist Supervisor Frank Durham of his training during a 2006 interview.

In the late 1960s, firearms, toolmarks, and fingerprint examinations began to transition to civilian examiners. In 1968, Tom Buel, who had been the Patrol's civilian photographer since 1965, added firearms, toolmarks, and footwear to his duties. In 1975, he began a two-year apprenticeship program in questioned documents, which was taught by the Crime Lab's director, Captain Kenneth Miller. In 1974, Don Lock was hired to perform latent print examinations and, along with Tom Buel and August Nilges, began analyzing questioned documents. Lock had previously worked in the Patrol's Criminal Records Division classifying and identifying inked prints. In 1987, he became the supervisor of both the Questioned Documents and Latent Print sections of the laboratory.

In the early 1980s, chemists became more specialized because increasing workloads and advances in technology made it impractical to be a generalist. During that time, the Serology Section of the laboratory, which was using polymorphic enzyme comparisons and blood typing, started making advances that would lead to the development of the present DNA casework section.

"They can do so much more now than we could do then. ... there were times we could not say there was definitely a match. Now, with DNA, they can make positive matches. The instrumentation is much more involved. Initially, a lot of the chemical procedures were very tedious and took a long time. It isn't easy now, but it's different," said Durham (2006).

Today, the General Headquarters laboratory is a full-service crime laboratory that provides services in firearms and toolmarks, latent prints, trace evidence, DNA casework, DNA databasing (CODIS), drug chemistry, and toxicology.

Expanding the Lab System

There have been three distinct phases of expansion of the Missouri State Highway Patrol's Crime Laboratory Division. The first phase occurred in the 1970s at Macon (Troop B), Willow Springs (Troop G), and St. Joseph (Troop H).

The first satellite laboratory opened in February 1975 in the basement of the Troop G Headquarters in Willow Springs. In September 1997, crime lab staff moved into a new laboratory facility built on the grounds of Troop G Headquarters.

The Troop H Satellite Laboratory, located on the grounds of Troop H Headquarters in St. Joseph, and the Troop B Satellite Laboratory, located on the grounds of Troop B Headquarters in Macon, both opened in February 1977. In 1988, additions to each original laboratory structure nearly doubled the space of each laboratory.

The second phase of expansion occurred in the early 1990s. The Troop C Satellite Laboratory was opened in January 1992. The laboratory was originally operated as the Jefferson County Regional Crime Laboratory, under the authority of the Jefferson County Sheriff's Department. It was located on the campus of Jefferson College in Hillsboro, MO. When the regional laboratory closed, the previous management requested the Patrol take over the operation of the laboratory. A new

laboratory facility was constructed in April 1999, on the campus of Mineral Area College in Park Hills, MO.

The Troop D Satellite Laboratory opened in January 1993, to serve the Patrol's needs in the Southwest Missouri region. Soon afterward, the Springfield Police Department elected to close its regional crime laboratory. A merger occurred between the Springfield Police Department's regional crime lab and the Troop D Satellite Lab, resulting in the Highway Patrol crime lab system taking over the functions of the regional lab.

In 2008, a new lab facility was constructed in Springfield, which involved the rehabilitation of a 1920s era warehouse in an area of Springfield undergoing revitalization. The lab was outfitted using a combination of state, local, and federal funds. While the previous Troop D lab only performed solid dosage drug analyses and blood alcohol determinations, the new 30,000 square foot facility is a full-service crime lab offering all forensic disciplines, including drug chemistry, toxicology, trace evidence, latent prints, firearms and toolmarks, and DNA. This new full-service lab now provides a much-needed expansion of analysis capacity for the fast-growing Southwest Missouri region.

The third phase of expansion occurred in the mid-2000s. In 2006, the Southeast Missouri Regional Crime Lab in Cape Girardeau became part of the Missouri State Highway Patrol Crime Laboratory Division. It is located near the campus of Southeast Missouri State University and serves the Southeast Missouri region. The lab was originally founded under the leadership of Dr. Robert C. Briner in 1970, through funding received from a federal grant program. It operated under the administrative auspices of Southeast Missouri State University (SEMO).

For over 30 years, the SEMO lab was funded by federal and state grants, as well as through local agency fees for service. Relying on these uncertain funding sources made it increasingly difficult for the SEMO lab to maintain the services that the local law enforcement community needed. Through the efforts of Senator Rob Mayer, Senator Jason Crowell, and Representative Scott Lipke, funding was provided to merge the SEMO Crime Lab into the Missouri State Highway Patrol Crime Lab Division. Governor Matt Blunt approved the merger and signed the budget, establishing the funding to make this merger possible.

On July 1, 2006, the seven employees of the SEMO Crime Lab officially became employees of the Missouri State Highway Patrol. The new Troop E Satellite Lab achieved accreditation through the American Society of Crime Laboratory Directors/Laboratory Accreditation Board (ASCLD/LAB) in 2008, and gained approval from the FBI to participate in the CODIS DNA database shortly thereafter.

In 2007, the Missouri Southern State University (MSSU) Regional Crime Lab, located on the campus of MSSU in Joplin, became part of the Missouri State Highway Patrol crime laboratory system. It serves the extreme Southwest Missouri area. The MSSU regional lab was founded under the leadership of Dr. Phillip Whittle in the 1970s through funding received from a federal grant program. The laboratory served many law enforcement agencies in Southwest Missouri and adjacent parts of Oklahoma, Arkansas, and Kansas.

For over 30 years, the MSSU Regional Crime Lab was funded by federal and state grants, as well as through local agency fees for service. As was the case with the SEMO lab, relying on these uncertain funding sources made it increasingly difficult for the MSSU lab to maintain the services that the local law enforcement community needed. Through the efforts of Senator Gary Nodler, funding was provided to merge the MSSU Regional Crime Lab into the Missouri State Highway Patrol Crime Lab Division. Governor Matt Blunt approved the merger and signed the budget, establishing the funding to make this merger possible.

On June 1, 2007, the seven employees of the MSSU Regional Crime Lab officially became employees of the Missouri State Highway Patrol. In 2009, the Missouri Southern State University reallocated the rooms occupied by the crime laboratory. In response to losing this facility, a new laboratory was built in Carthage at the local Highway Patrol Troop D Service Center. The new 6,000-square-foot facility opened for business in September 2010. This laboratory offers services in latent prints and drug chemistry and has room for further expansion.

Today, the Crime Laboratory Division consists of eight laboratories and one evidence drop-off kiosk. The division employs 124 full-time employees divided among those nine locations.

Developing DNA Analysis Capabilities

One of the most transforming changes made at the Crime Laboratory Division was the development and implementation of human DNA analysis in criminal casework and human DNA profiling to provide statistics-based investigative leads to criminal investigators.

Colonel C.E. Fisher attended a meeting in 1988, where a new testing procedure that "typed" a person's DNA was discussed. Col. Fisher returned to Jefferson City and discussed with Laboratory Director Lt. Frank Burkhead the pros and cons of DNA typing. They agreed the MSHP Crime Laboratory should be on the cutting edge of technology and that the timing was right for implementation of this new technology in Missouri.

Soon after this discussion, the FBI Laboratory began soliciting applicants for their Visiting Scientist Program at their research lab at the FBI Academy in Quantico, VA. This program was instituted so state and local forensic scientists from the United States could work together with FBI researchers to develop a national system for analyzing human DNA. All participants would be taught the same techniques and procedures for typing human DNA. Since all the labs in the country would be using the same techniques, their results would be compatible and could be incorporated (eventually) into a national DNA database. The FBI benefited by developing a consistent analytical system and by utilizing the labor of the scientists from the participating labs to develop a national DNA population database that could be used to calculate the rarity of a DNA type. In April 1988, Lt. Burkhead received one of the applications and discussed with Tom Grant, the supervisor of the MSHP Lab's Serology Section, the possibility of applying. Grant returned the application and in July 1988, the FBI sent a letter confirming that Grant had been chosen as one of the first visiting scientists. His participation included four months of resident service at the research lab in Quantico.

For four months, Grant helped work on the population database and was trained to perform Restriction Fragment Length Polymorphism (RFLP) DNA analysis. His new knowledge helped equip the DNA Section of the laboratory. Lt. Burkhead committed lab funds to purchase the necessary equipment to set up a DNA testing laboratory.

When Grant returned to Missouri in February 1989, the General Headquarters laboratory was equipped and ready to begin validation of DNA analysis methods. Staff training started and progressed rapidly. On October 1, 1990, the first DNA case was started in the MSHP Crime Laboratory. The techniques continued to develop over the years and, in 1999, Polymerase Chain Reaction using Short Tandem Repeats was instituted with casework samples and is the technique in use today. Over the past 20 years, much has changed in the field of DNA analysis -- new techniques, faster turnaround times, and more discriminating results. The DNA Section staff has expanded from three employees in one lab to 28 employees in three labs across the state.

The FBI Visiting Scientist Program may have been the initial link to catapult the crime lab into more advanced DNA sequencing, but over 20 years later the DNA section continues to be on the cutting edge of technology.

Laboratory Specialization

In the mid-1980s, forensic chemists performed all chemistry examinations, forensic serologists performed enzyme typing on stains, and forensic analysts performed latent print, and firearm/toolmark analyses. It soon became apparent that the chemistry and serology disciplines had become too specialized for chemists and serologists to remain proficient in all examinations. In 1986, the Trace Evidence Section and Toxicology Sections were formed. The Trace Evidence Section was formed to analyze hairs, fibers, glass, paint, light bulb filaments, gunshot residue, soil, fire debris, paint, and unknown substances for identification. The Toxicology Section was formed to analyze body fluids for the presence of ethyl alcohol and drugs. The remaining chemists who had primarily analyzed solid dosage drugs formed the Chemistry Section. The result was a full-service laboratory with six basic forensic disciplines: Chemistry, Toxicology, Trace Evidence, Serology (later DNA), Firearms/Toolmarks, and Latent Prints. The analysis of questioned documents was phased out in 2003.

The DNA Database

In 1991, Senate Bill 578 was passed requiring the collection and processing of DNA samples from convicted felons of certain violent crimes and to record them in a state and national database. The DNA Profiling Section of the laboratory was established to perform these new duties. This section collects and analyzes these DNA samples, and enters the resultant DNA profiles into the state and national DNA database, Combined DNA Index System (CODIS). Those profiles are compared to the DNA profiles from evidence collected at crime scenes.

The passage of Senate Bill 1000 during the 2004 legislative session (effective January 1, 2005) had a tremendous impact on law enforcement's ability to solve crimes using the CODIS database. This legislation expanded Missouri's offender DNA database law to require collection of DNA from all convicted felons. The expansion

of this program is funded by a court fee of \$30 assessed on every felony conviction and \$15 on every misdemeanor conviction in the state. This law increased annual DNA submissions to the Missouri State Highway Patrol Crime Laboratory from an estimated 2,200 offender samples per year to over 28,000 per year. Additionally, 100,000 DNA samples were required to be collected immediately from prior offenders eligible for past felony convictions. A seven-year plan was instituted to eliminate this backlog of samples and stay current with the new samples arriving. The employees of the DNA Profiling Section were able to eliminate the entire backlog in just two years. Because of their dedication and efficiency, the section was presented with the 2006 Governor's Award for Quality and Productivity in a ceremony at Missouri's Capitol.

In the 2009 legislative session, the database law was expanded again with the passage of HB 152 requiring the collection of individuals arrested for qualifying crimes. It has long been known that a large percentage of serious crimes are committed by persons previously convicted of lesser felony offenses. This offender database is used to search against forensic DNA samples from unsolved crimes at the state and national level. The Missouri forensic database contains DNA from thousands of unsolved crimes and it is constantly searched against newly entered offender DNA samples. In the 12 prior years under the old law, the Crime Laboratory analyzed a total of 27,211 convicted offender DNA samples and uploaded the profiles into the state and national CODIS database. Since the change in the law took effect, the database has increased in size from 27,211 DNA profiles to over 386,000 convicted offender profiles in 2020.

As expected, the large increase in DNA profiles from relatively recent offenders has resulted in a tremendous increase in CODIS "hits," where old, unsolved crimes have hit against a newly collected offender. For 2004, the last year the laboratory worked under the old law, a total of 41 CODIS "hits" occurred. In 2005, the first year under the "all felon" law, hits increased to 175. In 2020, there were 1,165 investigations aided by CODIS hits. While the majority of hits were related to property crimes such as burglary, they also included 114 homicides, 74 assault cases, and 192 sexual offenses. A number of these hits were very high-profile cases. Without this valuable tool, these crimes would have remained unsolved.

The power of CODIS resides in its ability to identify perpetrators of unsolved crimes. The database also has the potential to identify repeat offenders, and in doing so, helps reduce or prevent the occurrence of serial crimes. The high degree of certainty that DNA analysis provides has caused it to become one of the most important criminal justice tools ever utilized. DNA is equally effective in exonerating as it is in convicting the guilty.

A Case Study: Governor Carnahan's Plane Crash

On October 16, 2000, a Cessna airplane piloted by Randy Carnahan, son of Governor Mel Carnahan, crashed on a heavily wooded hillside south of St. Louis near Hillsboro, MO. Gov. Carnahan and his aide, Chris Sifford, were the other occupants of the plane. All three men were killed in the crash.

Using 10-print cards and the newly developed DNA standards, criminalists could positively identify which biological crash materials belonged to each of the three deceased. Working around the clock, the lab could make many of these identifications in time for the funeral arrangements a few days later. DNA results were eventually used by the Federal Aviation Administration to resolve identification issues with some of the tissue samples they subjected to toxicology examinations.

Additional examinations were performed by the Trace Evidence and Drug Chemistry sections to analyze aviation fuel samples for contaminants and analyze an unknown powder found at the site, respectively.

On March 7, 2001, the Missouri House of Representatives, 91st General Assembly passed House Resolutions 761 through 771, recognizing the exemplary work performed by Crime Laboratory Division personnel during this time of crisis. It serves as public testament to their competence and professionalism.

A Case Study: The Joplin Tornado

On Sunday May 22, 2011, an EF-5 tornado struck Joplin, MO. It was deemed the deadliest tornado in the United States since 1953, and the eighth deadliest on record. The total death toll was 162. The Crime Laboratory DNA sections (including CODIS) and Latent Print sections were tasked with assisting in identifying victims. Criminalists processed 128 morgue samples and 129 family reference samples, for a total of 257 total DNA samples, in four days. Although most identifications of victims were affected by more traditional means such as medical records, dental records, and fingerprints, five total unidentified human remains identifications were affected by the MSHP DNA sections.

Recent Significant Events:

- In 2016, the Crime Laboratory Division hosted the 45th annual meeting of the Midwestern Association of Forensic Scientists (MAFS). This was the first time the MSHP hosted a MAFS meeting or any meeting of this magnitude on its own. The meeting was attended by a total of 318 scientists from around the country. In addition to the leadership and planning component of the meeting, seven of our criminalists presented papers on interesting cases, research, or backlog reduction strategies. Five of our criminalists taught workshops and one criminalist took the American Board of Criminalistics biology certification exam.
- In 2016, the Latent Print Section implemented the AFIS upgrade to MorphoBIS. The MorphoBIS database includes the most current algorithm on the market for AFIS databases. Since implementation of MorphoBIS, the Latent Print Section has experienced a 55% increase in "hit rate" in the AFIS database. To put this in perspective: In 2015, our lab system experienced a total of 330 latent print "hits" in AFIS. In 2016, our total was 601 latent print "hits" in AFIS.

- From March through May 2017, the General Headquarters Toxicology Section underwent a comprehensive remodel. During the 2018 legislative session, the laboratory was budgeted three new, full-time employees for toxicology. Both factors resulted in an overall increase in throughput and decrease in toxicology backlogs.
- In 2018, the laboratory was given permission to spend approximately \$2.9 million to build an addition to the General Headquarters laboratory. The facility was completed in 2020. It was designated for DNA operations.
- In 2018, the DNA Casework Section purchased a Rapid DNA instrument. Rapid DNA analysis is a term used to describe the fully automated (hands free) process of developing DNA profiles from a single instrument without human intervention. With this instrument, the laboratory can analyze a single source DNA sample in 90 minutes, a process that previously took over 12 hours.
- In 2018, the toxicology discipline purchased the laboratory's first Liquid Chromatography–Mass Spectrometer instrument to be used for toxicology work. The LC/MS instrument allows our criminalists to screen, confirm, and quantify drugs in blood and urine with precision beyond the capabilities of previous instrumentation.
- In 2019, the Crime Laboratory Division was budgeted five additional, full-time employees to create a new DNA Screening Section. This new section is housed in the new DNA addition. This unit focuses on screening sexual assault kits to reduce backlogs.
- In 2020, the Crime Laboratory Division began outsourcing sexual assault kits to a private vendor. Through two separate grants, A SAKI grant in partnership with the Missouri Attorney General's Office, and a VOCA grant secured internally, the Crime Laboratory Division outsourced 2,500 sexual assault kits to affect a more expedited throughput of the case outcome.
- During the pandemic of 2020, the Crime Laboratory Division developed a "no contact" evidence submission/return system and leveraged evidence lockers where they had them installed.
- During the 2020 pandemic, Crime Laboratory Division employees predominately remained in the workplace with minimal disruption and minimal infection or quarantine. On any given day, the division was staffed at approximately 90%.
- During the 2020 pandemic, telework was implemented for predominately digital disciplines such as latent prints. Telework for other more analog disciplines such

as drug chemistry was more challenging, but was used to some effect where it benefitted both the criminalist and organization.

Conclusion:

The Missouri State Highway Patrol Crime Laboratory Division has been in existence since 1936. According to a biennial report of the Patrol, the laboratory worked 230 cases in 1937-1938. From those humble origins in 1936, the division has evolved into a nationally respected and internationally accredited crime laboratory system that is a recognized leader in state-of-the-art forensic science services in the 21st century.

Since its creation, the Crime Laboratory Division has accepted submissions from any Missouri law enforcement agency. Presently, approximately 80 percent of the cases received by the Crime Laboratory Division are submitted by outside agencies such as municipal police departments, county sheriff's departments, and county coroners. Forensic lab services are provided to these submitting agencies at no charge.

Forensic examination of evidence has become essential for the successful investigation and prosecution of criminal cases. In 2020, the crime lab received 27,687 cases and issued over 36,181 reports across all forensic disciplines. Today, the laboratory employs a total of 124 full-time employees at eight laboratory locations, including two full-service laboratories and an evidence drop off kiosk.

Missouri State Highway Patrol criminalists are highly trained and dedicated to providing quality forensic science services to all law enforcement agencies in the state. Crime Laboratory Criminalists hold over 175 memberships in over 17 different forensic professional organizations to include MAFS, AAFS, ASCLD, and SOFT. In addition to our work in the crime laboratory, our criminalists participate as board members, committee members, and assessors for forensic professional organizations (e.g. Organization of Scientific Area Committees, American Society of Crime Laboratory Directors, ASNI National Accreditation Board, National DNA Index System, Midwestern Association of Forensic Scientists, and Missouri International Association for Identification.)

Forensic science has been an integral part of the criminal investigation process for many years, and this relationship has only grown stronger through time. The pride and commitment to quality that defined the laboratory in 1936 still endures today.