For nearly twenty-five years, Applied Biosystems has led the development and commercialization of DNA detection and analysis technologies providing innovative systems that allow human identification and forensic scientists to maximize their use of DNA in solving crimes and establishing identity. Applied Biosystems range of human identification products allow laboratories to determine paternity, identify biological remains of military personnel or disaster victims, and victims and perpetrators associated with criminal investigations.

With its products utilized by more than 1,000 customers worldwide, Applied Biosystems is working closely with the human identification community to help improve laboratory workflow, eliminate sample backlogs, increase training and establish DNA as a standard for identity.

**Hunting Sexual Predators**

On March 3, 1989, Debbie Smith was kidnapped from her home while her husband, a police officer, was sleeping upstairs. She was dragged into the woods behind her Williamsburg, Virginia home and raped. Six and a half years later, her perpetrator was finally caught when a match was discovered using the Federal Bureau of Investigation's CODIS (Combined DNA Index System) DNA database. The man who sexually assaulted Debbie had abducted and robbed two other women before he was caught. Utilizing the DNA match, Debbie’s attacker was ultimately convicted of rape, abduction, robbery, burglary and larceny. He was sentenced to two life terms plus 25 years in prison.

A proportionately large number of all criminal casework samples are mixtures of male and female DNA, such as samples collected from sexual assaults. To increase the speed at which these samples are processed, analyzed and submitted to DNA databases, Applied Biosystems offers DNA quantification systems with real-time PCR instruments. These integrated systems, enable forensic analysts to quickly and reliably quantify the amount of amplifiable human or male-specific DNA.
Catching Criminals with DNA Databases

In a recent study conducted by the City of Chicago’s Mayor’s Office, it was shown through an examination of the criminal activities of eight individuals that 60 violent crimes, including 53 murders and rapes, could have been prevented had DNA been collected from eight serial killers and rapists during any of their felony arrests.

Offender DNA databases have been instrumental in assisting law enforcement investigations and have made intrastate and international investigations possible. In the United States, state DNA databases are inter-connected with the FBI Laboratory’s Combined DNA Index System (CODIS). CODIS enables federal, state, and local crime labs to exchange and compare DNA profiles electronically, thereby linking crimes to each other and to convicted offenders. Based on a match, law enforcement professionals in multiple jurisdictions can coordinate their respective investigations, and share the leads they developed independently. As of March 1, 2006, DNA entered into the FBI CODIS database has assisted in over 31,776 investigations nationwide.

The proliferation of state DNA databases is vastly increasing law enforcement’s ability to solve difficult and even ‘cold’ cases that remain unsolved but “on the books.” Working with state, federal and international agencies, Applied Biosystems has developed DNA analysis systems that enable the rapid processing and submission of DNA profiles to databases worldwide.

Identifying Missing Persons

Each year more and more missing persons are reported to law enforcement agencies. In the United States, between 1982 and 2000, there was a 468% increase in the number of missing persons reported. Of the 876,213 people that were reported missing in 2000 85-90% were juveniles.

In 2003, Applied Biosystems provided the DNA Laboratory of the California Department of Justice (DOJ) with a state-of-the-art DNA analysis system to support the DOJ’s Missing Persons DNA Program. Each year in California, approximately 100 sets of human remains, including those of many children, are added to the approximately 2,100 sets of unidentified remains dating as far back as 1959. Because most go unidentified, it is hoped that the Missing Persons DNA Program will allow major advances in efforts to identify these remains and will serve to give closure to families, as well as to provide information that may assist ongoing police investigations.

Protecting Innocence

In 1982, microscopic hair comparisons provided the evidence necessary to convict two men for murder in Oklahoma. One of the men was five days away from being executed when a federal judge ordered that DNA tests be conducted. The results generated from this analysis showed that these two men were innocent and led to a “cold-hit” investigation which yielded the real killer.
While thirty-nine states provide convicted persons access to DNA testing, many of these testing laws are very limited in scope and substance. Congress has shown its support of post conviction DNA testing, however, by passing the Justice for All Act (H.R. 5107), which specifies the level of post-conviction DNA access required by states seeking to qualify for funding under that act. This is part of a broader trend to increase access to post-conviction DNA testing.

Applied Biosystems provides a comprehensive set of advanced DNA analysis tools that enable forensic analysts to statistically determine human identity to accuracy levels as high as one person in one trillion. These validated systems ensure that results are accurate and reproducible so that the real criminals can be pursued.

Establishing Standardized and Validated Systems

Since its introduction to the criminal justice system in the 1980s, forensic DNA analysis has benefited from the presence of traceable methods and validated standards for the collection and stewardship of physical biological evidence. For DNA analysis to maintain its important role as a defensible tool for identification, international standards and reference materials need to continually be established, evaluated and monitored.

The work of organizations such as the Scientific Working Group on DNA Analysis Methods (SWGDAM), the Federal Bureau of Investigation (FBI), the European Network of Forensic Science Institutes (ENFSI) and the National Institute of Standards and Technology (NIST) have all made major contributions to helping law enforcement professionals and forensic scientists around the world maintain the physical integrity of biological evidence. The added value of having rigorous audit, proficiency and accreditation programs in place ties together the standards and guidelines component to ensure a quality system.

Applied Biosystems provides advanced training programs for forensic professionals and works closely with regulatory agencies around the world to ensure that its human identification products improve and streamline a forensic laboratory’s capacity to deliver validated procedures and defensible results.

The Future of Human Identification

The application of DNA analysis technology to human identification has arguably had the greatest impact on our society as any application since the discovery of the structure of DNA. In the future, advancements in the field of human identification will be accelerated by increases in automation to enhance overall efficiency and productivity in forensic laboratories from sample preparation through data analysis. Further, DNA typing systems that can someday be used in the field at a crime scene will provide even greater benefits to society by enabling real-time analysis of samples that could immediately indicate a perpetrator or exonerate an innocent suspect.

Validated Systems for Regulated Applications

The AmpF/STR® Identifiler® PCR Amplification Kit simultaneously amplifies 15 STR loci plus the Amelogenin gender-determining marker in a single, robust PCR reaction. The widely accepted tetranucleotide loci co-amplified in the Identifiler® kit include the thirteen core STR loci standardized under the FBI’s Combined DNA Index System (CODIS). The data generated from these loci also satisfy the recommendations of the ENFSI and Interpol organizations.
In the next five years, the most significant advancements in the field of human identification will include new methods designed to enhance overall efficiency and productivity in forensic laboratories. New technologies, including miniature short tandem repeats (STRs) that utilize smaller pieces of DNA, promise to enable the analysis of degraded and compromised samples, such as samples taken at mass disaster scenes that may have been exposed to extreme elements. Progress in this area is expected to dramatically improve the ability to recover probative information from low level samples and can be applied to a broader range of forensic DNA applications.

Methods developed to examine low copy DNA samples may also provide forensic analysts a new way to apply DNA typing technologies to a broader range of evidentiary materials, such as fingerprints. The analysis of “touch DNA” would allow investigators to extract DNA from fingerprints found in older cases and broaden the types of cases that could benefit from this use of DNA typing technology. In addition, novel methods used to identify time-of-death, physical traits, animals, dust and pollen will increase forensic analysts’ ability to extract probative information from DNA across a wide variety of biological materials.

As new methods and technologies emerge, the process of validation and implementation in the forensic laboratory’s workflow becomes a continual process. The effort required by laboratories to validate new technologies is rigorous; however, the importance of integrating innovative technologies must remain a top priority for crime laboratories worldwide. New tools designed for DNA analysis will facilitate the investigative process. For example, first generation semi-portable DNA typing systems are in development for on-site analysis. In the near future these systems will be miniaturized into handheld portable systems that can be used at a crime scene, enabling real-time analysis of samples that can be immediately applied to evidence and further used to identify a perpetrator or exonerate an innocent suspect.

With each of these advancements, investigators inherit tools that lead them closer to answering the diverse questions that accompany crime scenes, missing persons cases, and mass disasters. Applied Biosystems, as the leader of DNA typing reagents, instrumentation, software, and support, promises to lead the advancement of forensic DNA typing technologies by continuing to grow our steadfast commitment to innovation, quality, and support of forensic laboratories worldwide.