The Science of DNA Forensics: Growing Pains and Ethical Challenges

A drop of blood, a single hair, or even the saliva under a postage stamp -- each contains enough DNA to positively identify a person. Known as DNA forensics, the science of identifying people by their DNA has proved an invaluable tool for solving crimes, identifying victims' remains, and exonerating those who were wrongly convicted, including several on death row. While there is widespread agreement that the use of DNA evidence in law enforcement has tremendous potential to promote justice, it nevertheless raises significant legal, ethical, and social concerns.

DNA forensics takes advantage of the fact that all individuals, with the exception of identical twins, have a unique DNA code. Copies of the code are tightly packed into nearly every cell in the body.

DNA has three additional characteristics that make it an ideal tool for forensic investigators:
1) DNA is chemically stable: Decades-old crimes have been solved through DNA evidence that was carefully labeled and properly stored.
2) Only trace amounts are needed to generate a DNA profile.
3) DNA profiles are easily catalogued into computer databases, allowing investigators to efficiently compile and search data.

Developing a DNA profile begins with the careful collection of a sample at a crime scene. Standard protocols are followed to prevent contamination of the sample with unrelated DNA or chemicals that can interfere with analysis. In a laboratory, DNA is extracted and tests are performed to ascertain its quality and quantity. Next, a DNA profile is generated through what is called "DNA typing."

Although the DNA code from one person to the next is approximately 99.9 percent identical, scientists have identified regions, where the code reliably varies. Within these regions are what are known as short tandem repeats (STRs), sections of the DNA code that repeat over and over. The number of repeats varies from person to person; in the U.S., 13 STRs are used to make up a DNA profile.

A technique called polymerase chain reaction makes billions of DNA copies of the 13 STRs. Using this approach, forensic analysts can examine even extremely small or degraded samples. Since the number of repeats for each of the 13 STRs varies from person to person, the 13 STRs together compose a profile.

DNA forensics can link suspects to crime-scene evidence or, in cases where the suspect has been identified through other evidence, can strengthen the case the prosecution makes to the jury.

The Combined DNA Index System (CODIS) was launched by the FBI in 1998 to assist in cases where no suspect has been identified. CODIS is a software system designed to match DNA profiles compiled by two types of databases: the Forensic Index, which searches DNA profiles generated from crime scene evidence; and the Offender Index, which searches DNA profiles of potential suspects. The system searches databases maintained by local, state, and federal agencies.

The enormous success of CODIS has resulted in a deluge of samples, creating huge backlogs at forensic labs. The 2003 National Forensic DNA Study Report concluded that both state and local crime laboratories are "overworked, understaffed, and insufficiently funded," leading to average delays of 24-30 weeks to process DNA samples. The Department of Justice has since awarded more than $100 million in grants to reduce this backlog and help law enforcement agencies better utilize DNA forensics.

While DNA forensics is seldom challenged on its scientific accuracy, there is disagreement over how DNA databases should be used in law enforcement and whose profiles should be included in them. As the technology evolves, so too must safeguards that protect the rights of innocent citizens.

Compiled by Dustin Hays
Last updated 8/2008 by Sara Katsanis