Testimony of

ERIC S. LANDER, Ph.D.
President and Founding Director, Broad Institute of Harvard & MIT
Professor of Biology, MIT
Professor of Systems Biology, Harvard Medical School

Co-chair, President's Council of Advisors on Science and Technology (PCAST)

Before the
United States Senate
Committee on Commerce, Science, and Space

Forensic Science

March 28, 2012

Chairman Rockefeller, Ranking Member Hutchison, and Members of the Committee:

Thank you for inviting me here today to speak to you about an issue of tremendous importance for our Nation and our justice system: ensuring the quality and consistency of forensic science relied upon in criminal proceedings.

My name is Eric Lander. I am the President and Founding Director of the Broad Institute of Harvard and MIT, which was the leading contributor to the International Human Genome Project a decade ago and works today at the forefront of genomic medicine. I am also the co-chair of President Obama's Council of Advisors on Science and Technology (PCAST), which is the external scientific advisory group to the White House. I want to emphasize, however, that I am not here today to represent the Administration's position. Rather, I have been asked to testify based on a longstanding personal interest that traces back 23 years, to my involvement in the earliest days of DNA fingerprinting.

Today, we consider DNA fingerprinting to be the gold standard for forensic science. It's a staple on television in the fictional crime-solving on "CSI" and on "Law and Order"; and in reality, it is a technology with amazing sensitivity and near-flawless accuracy.

But, this wasn't always the case.

In 1989, I participated in one of the first DNA fingerprinting cases in the United States – a New York case called *People v. Castro*. Because DNA fingerprinting was such a new technology and I was a molecular geneticist with expertise on the human genome, the defense asked me to review the evidence and to testify in a pre-trial hearing on the admissibility of the DNA evidence. I did so reluctantly and insisted on doing so *pro bono*.

To make a long story short, the evidence turned out to be appalling. There were no objective standards for declaring when two DNA bands matched; for deciding when non-matching bands could be ignored as 'noise'; or for calculating the probability of a match. The testing labs were issuing breathtaking statements that particular DNA patterns had frequencies of less than one in 10 billion – in effect, asserting that they were unique, despite the lack of any rigorous support for these claims.

The pre-trial hearing lasted for 15 weeks. Near the end, the scientific experts who had testified for the defense and the prosecution took an unusual step – unusual, at least, for the legal system. We decided to have a one-day joint scientific meeting to review the evidence together, without the lawyers or judges.

At the end of the day, the scientific experts for the prosecution agreed with those for the defense that the DNA evidence was unacceptable. They decided to switch sides

and testify for the defense. Needless to say, the judge excluded the DNA evidence – deciding that DNA fingerprinting was reliable in theory but not as practiced.

It was a triumph of the scientific method and the scientific culture.

Following the case, I worked with others to ensure that we had reliable standards for DNA fingerprinting. I had the pleasure to work closely with extraordinary public servants in the FBI's Crime Lab, including Bruce Budowle, of the FBI's unit at Quantico. And, I served on the first of two committees assembled by the US National Academy of Sciences on DNA fingerprinting. Sometime later, I also agreed to serve on the Board of the Innocence Project.

Within about five years, DNA fingerprinting was put on firm foundation – through a robust collaboration of law enforcement on the one hand and independent scientists on the other. It was the alchemy of rigorous scientific attention that turned DNA fingerprinting from base metal into the gold standard it is today.

At the beginning, the law enforcement community had serious concerns about inviting independent scientists to set standards because they worried that it might weaken DNA fingerprinting as a law enforcement tool. In fact, DNA became a stronger tool for the police and prosecutors – making it possible to revive cold cases, to catch serial rapists and murderers. And, DNA also became a stronger tool for the defense to protect those who were wrongfully accused.

In the end, DNA became a tool not for the prosecution or for the defense, but for the truth, which is the main goal. When we fail to find the truth, we may fail society in two ways – by locking up an innocent person and by leaving a criminal free to commit more crimes.

The power of DNA fingerprinting had another unexpected and very important consequence. For the first time, it gave us a way to revisit old cases and to prove that some people had been wrongfully convicted – to prove that hundreds of people in jail were actually innocent; to prove that at least 17 people who had been on death row were actually innocent; and to infer that, in all likelihood, at least some people who had been executed were actually innocent.

Because many of these wrongful convictions involved forensic science, it became important to ask how the forensic science testimony could have been wrong. The goal here is not to point fingers. The goal is to identify errors, understand the reasons and improve the science so that it is accurate. That's how science advances in research labs and in clinical labs. And, it is how science must advance in the justice system.

We have learned a lot, both from legal cases and from scientific studies, about the need for improving forensic science.

A paper by Garrett and Neufeld in 2009 reported that, in 137 cases where transcripts of forensic testimony were available and a convicted person was later exonerated by DNA evidence, roughly 60% involved problematic forensic testimony.

The cases included ones like that of an honorably discharged veteran who was wrongly convicted of murder in Arizona based in part on a comparison of a Styrofoam impression of his teeth with bite marks on a murder victim's neck. DNA testing eventually led to the veteran's exoneration in 2002. (In fact, the actual perpetrator went on to attack a young girl 20 days after the murder, a crime that might have been prevented had the police had the right suspect.)

In another illuminating case, a man was convicted of rape and murder in New York, in part on the basis of hair analysis, soil comparison, and fabric print analysis. The forensic expert reported similarities of hair, soil and fabric prints from the man's truck and from the crime scene and victim. Yet, there were no empirical data on the frequency of those materials, so no way to know how common such characteristics or "matches" might be. DNA testing eventually exonerated the man nearly 20 years after his conviction.

In 2009, the National Academy of Sciences issued an important and thoughtful report about strengthening forensic science. It cited serious issues with the analysis and interpretation of forensic evidence.

It cited, for example, an FBI study that found that 1/8 of hair samples said to "be associated" based on microscopic comparison were subsequently found to come from different people based on DNA analysis.

It noted serious issues with bite marks, tool marks, and fiber comparisons, including the lack of objective standards and the lack of meaningful data and databases from which the probability of matches can be inferred. It identified issues with fingerprints, whose evidentiary value depends importantly on the quality of the latent fingerprint image and for which fully validated analysis methods are still needed.

The report stated that: "With the exception of nuclear DNA analysis, however, no forensic method has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between evidence and a specific individual or source. In terms of scientific basis, the analytically based disciplines generally hold a notable edge over disciplines based on expert interpretation. But there are important variations among the disciplines relying on expert interpretation. For example, there are more established protocols and available research for fingerprint analysis than for the analysis of bite marks. There also are significant variations within each discipline. For example, not all fingerprint evidence is equally good, because the true value of the evidence is determined by the quality of the latent fingerprint image. <u>These disparities between and within the forensic science disciplines highlight a major problem in the forensic science</u>

community: The simple reality is that the interpretation of forensic evidence is not always based on scientific studies to determine its validity. This is a serious problem. Although research has been done in some disciplines, there is a notable dearth of peer-reviewed, published studies establishing the scientific bases and validity of many forensic methods." [Emphasis added].

I should emphasize that the problem is often not with the technology per se. As we saw with DNA fingerprinting, it is often that there is a lack of serious scientific standards for analysis and interpretation – that is, (1) methods for deciding that two samples are similar matches and (2) methods and databases for attaching meaningful probabilities to such similarities. Without scientific standards for measurement, analysis and interpretation, expert opinion is not scientific and thus not meaningful in court.

What is the solution? As it was with DNA fingerprinting, the answer lies in drawing on two cultures – the criminal justice community, which understands most fully the needs for and uses of forensic evidence, and the independent scientific community, which understands most fully the principles of rigorous scientific analysis.

The National Academy of Sciences report was unambiguous that the task could not be accomplished within the criminal justice community alone. In particular, it concluded that "advancing science in the forensic science enterprise is not likely to be achieved within the confines of the [Department of Justice]". The National Academy report went so far as to recommend the creation of an independent National Institute of Forensic Sciences, within or associated with a science-based agency.

For my part, I think that it may be possible to achieve these goals through a partnership between the DOJ and two science-based agencies, NIST and NSF. But, it will be important that the partnership have clear and complementary roles.

[1] With respect to standards for forensic science:

DOJ clearly has a central role in (i) identifying the most important needs for forensic measurement, analysis and interpretation, and (ii) promoting the widespread adoption of good standards for forensic science throughout the justice system.

NIST clearly should take the lead in (i) identifying research gaps and weaknesses in forensic science and (ii) developing and proposing specific standards and best practices for forensic measurement, analysis and interpretation.

The two agencies should actively engage the other in the work, but it is important that the distinct activities have distinct leadership. Scientific standards should be based on robust input from the broad scientific community – not simply the input of forensic scientists or practitioners. As emphasized in the report from the National Academy of Sciences, scientific standard-setting should be led by a science-based

agency such as NIST, not units within DOJ. Conversely, the adoption of standards requires the perspective of practitioners. It should be led by DOJ.

In my opinion, the partnership between NIST and DOJ should be formalized through appropriate advisory committees or task forces with assigned responsibilities.

[2] With respect to forensic science research:

We need a robust scientific research agenda to support the development of a body of empirical knowledge on the validity of technologies and methods. This would greatly help the cause of advancing the status of forensic science.

While the National Institute of Justice (NIJ) provides some support for forensic science research, the program has very limited funding and engages a very limited scientific community – both in its grantees and its peer reviewers.

I believe that NSF has a critical role to play in supporting basic research underlying forensic sciences. The NSF engages the full breadth of the US scientific community in both research and peer review.

For both NIST and NSF, I do not want to create unfunded mandates. I believe that some additional funding will be required to NIST and to NSF to carry out these roles with respect to forensic science.

In closing, based on my experiences with the evolution of DNA fingerprinting, I believe it is possible that by bringing together the two cultures of science and justice, we can make large strides in advancing the quality of forensic science.

Again, I speak only for myself here. But, I am pleased to see that both the Executive and Legislative branches have become increasingly attentive to the issues of ensuring quality and consistency in forensic science. I am very hopeful about the various activities underway in both branches – including an ongoing process within the National Science and Technology Council, discussions in recent months among representatives of the departments and agencies that have equities in forensic science, and the interest of this Committee. With everyone's continued attention, we can enlist the full power of science in the service of justice.

Thank you.