

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. Charles M. Vest is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Harvey V. Fineberg is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. Charles M. Vest are chair and vice chair, respectively, of the National Research Council.

www.national-academies

Committee on Identifying the Needs of the Forensic Science Community

HARRY T. EDWARDS, (*Co-chair*), Judge, U.S. Court of Appeals for the District of Columbia Circuit

CONSTANTINE GATSONIS, (*Co-chair*), Director, Center for Statistical Sciences, Brown University

MARGARET A. BERGER, Suzanne J. and Norman Miles Professor of Law, Brooklyn Law School

JOE S. CECIL, Project Director, Program on Scientific and Technical Evidence, Federal Judicial Center

M. BONNER DENTON, Professor of Chemistry, University of Arizona

MARCELLA FIERRO, Medical Examiner of Virginia (ret.)

KAREN KAFADAR, Rudy Professor of Statistics and Physics, Indiana University

PETE M. MARONE, Director, Virginia Department of Forensic Science

GEOFFREY S. MEARNS, Dean, Cleveland-Marshall College of Law, Cleveland State University

RANDALL S. MURCH, Associate Director, Research Program Development, Virginia Polytechnic Institute and State University

CHANNING ROBERTSON, Ruth G. and William K. Bowes Professor, Dean of Faculty and Academic Affairs, and Professor, Department of Chemical Engineering, Stanford University

MARVIN SCHECHTER, Attorney

ROBERT SHALER, Director, Forensic Science Program, Professor, Biochemistry and Molecular Biology Department, Eberly College of Science, The Pennsylvania State University

JAY A. SIEGEL, Professor, Forensic and Investigative Sciences Program, Indiana University-Purdue University

SARGUR N. SRIHARI, SUNY Distinguished Professor, Department of Computer Science and Engineering and Director, Center of Excellence for Document Analysis and Recognition (CEDAR), University at Buffalo, State University of New York

SHELDON M. WIEDERHORN (NAE), Senior NIST Fellow, National Institute of Standards and Technology

ROSS ZUMWALT, Chief Medical Examiner, Office of the Medical Examiner of the State of New Mexico

Staff

ANNE-MARIE MAZZA, Study Director

SCOTT WEIDMAN, Director, Board on Mathematical Sciences and Their Applications

JOHN SISLIN, Program Officer, Board on Higher Education and Workforce

DAVID PADGHAM, Program Officer, Computer Science and Telecommunications Board (until 5/08)

STEVEN KENDALL, Senior Program Associate

KATIE MAGEE, Senior Program Assistant (until 9/07)

KATHI E. HANNA, Consultant Writer

SARA D. MADDOX, Editor

ROBIN ACKERMAN, Christine Mirzayan Science and Technology Policy Fellow

GEMAYEL JEAN-PAUL, Christine Mirzayan Science and Technology Policy Fellow

JOHNALYN D. LYLES, Christine Mirzayan Science and Technology Policy Fellow

SANDRA OTTENSMANN, Christine Mirzayan Science and Technology Policy Fellow

DEIDRE PARSONS, Christine Mirzayan Science and Technology Policy Fellow

SARAH RYKER, Christine Mirzayan Science and Technology Policy Fellow

SUNBIN SONG, Christine Mirzayan Science and Technology Policy Fellow

Committee on Science, Technology, and Law

DONALD KENNEDY (NAS/IOM), (*Co-chair*), President Emeritus and Bing Professor of Environmental Science Emeritus, Stanford University; Emeritus Editor-in-Chief, *Science*

RICHARD A. MERRILL (IOM), (*Co-chair*), Daniel Caplin Professor of Law Emeritus, University of Virginia Law School

FREDERICK R. ANDERSON, JR., Partner, McKenna, Long, & Aldridge LLP

MARGARET A. BERGER, Suzanne J. and Norman Miles Professor of Law, Brooklyn Law School

ARTHUR I. BIENENSTOCK, Special Assistant to the President for SLAC and Federal Research Policy, Stanford University

BARBARA E. BIERER, Senior Vice President for Research, Brigham and Women's Hospital

ELIZABETH H. BLACKBURN (NAS/IOM), Morris Herzstein Professor of Biology and Physiology, Department of Biochemistry and Biophysics, University of California, San Francisco

JOE S. CECIL, Project Director, Program on Scientific and Technical Evidence, Federal Judicial Center

RICHARD F. CELESTE, President, Colorado College

JOEL E. COHEN (NAS), Abby Rockefeller Mauzé Professor and Head, Laboratory of Populations, The Rockefeller University and Columbia University

KENNETH W. DAM, Max Pam Professor Emeritus of American and Foreign Law and Senior Lecturer, University of Chicago Law School

ROCHELLE COOPER DREYFUSS, Pauline Newman Professor of Law and Director, Engelberg Center on Innovation Law and Policy, New York University School of Law

ALICE P. GAST (NAE), President, Lehigh University

LAWRENCE O. GOSTIN (IOM), Associate Dean for Research and Academic Programs, Linda D. and Timothy J. O'Neill Professor of Global Health Law,

GARY W. HART, Wirth Chair Professor, School of Public Affairs, University of Colorado, Denver Georgetown University; Professor of Public Health, The Johns Hopkins University

BENJAMIN W. HEINEMAN, JR., Senior Fellow, Harvard Law School and Harvard Kennedy School of Government

DAVID BROCK HORNBY, Judge, U.S. District Court, District of Maine

DAVID KORN (IOM), Vice Provost for Research, Harvard University

RICHARD A. MESERVE (NAE), President, Carnegie Institution of Washington

DUNCAN T. MOORE (NAE), Professor, The Institute of Optics, University of Rochester

ALAN B. MORRISON, Visiting Professor, Washington College of Law, American University

HARRIET RABB, Vice President and General Counsel, Rockefeller University

PAUL D. RHEINGOLD, Senior Partner, Rheingold, Valet, Rheingold, Shkolnik & McCartney LLP

BARBARA ROTHSTEIN, Director, Federal Judicial Center

JONATHAN M. SAMET (IOM), Founding Director, Institute for Global Health and Chairman, Department of Preventive Medicine, University of Southern California

DAVID S. TATEL, Judge, U.S. Court of Appeals for the District of Columbia Circuit

Staff

ANNE-MARIE MAZZA, Director

STEVEN KENDALL, Senior Program Associate

Committee on Applied and Theoretical Statistics

KAREN KAFADAR, (*Chair*), Rudy Professor of Statistics and Physics, Indiana University

AMY BRAVERMAN, MISR Co-Investigator, Statistics and Data Analysis, Earth and Space Sciences Division, Jet Propulsion Laboratory

CONSTANTINE GATSONIS, Director, Center for Statistical Sciences, Brown University
MICHAEL GOODCHILD (NAS), Professor, Department of Geography, University of California,
Santa Barbara
KATHRYN B. LASKEY, Professor, Department of Systems Engineering and Operations Research,
George Mason University
MICHAEL LESK (NAE), Professor, Library and Information Sciences, Rutgers University
THOMAS A. LOUIS, Professor, Department of Biostatistics, Bloomberg School of Public Health,
The Johns Hopkins University
MICHAEL A. NEWTON, Professor, Department of Biostatistics and Medical Informatics,
University of Wisconsin, Madison
MICHAEL L. STEIN, Professor, Department of Statistics, The University of Chicago
Staff
SCOTT WEIDMAN, Director
NEAL GLASSMAN, Senior Program Officer
BARBARA WRIGHT, Administrative Assistant

CONTENTS

Preface	P-1
Summary	S-1
Introduction	
Findings and Recommendations	
1 Introduction	1-1
What Is Forensic Science?	
Pressures on the Forensic Science System	
Organization of this Report	
2 The Forensic Science Community and the Need for Integrated Governance	2-1
Crime Scene Investigation	
Forensic Science Laboratories and Service Providers	
Case Backlogs	
NIJ's Coverdell Forensic Science Improvement Grant Program	
Forensic Services Beyond the Traditional Laboratory	
Federal Forensic Science Activities	
Research Funding	
Professional Associations	
Conclusions and Recommendation	
3 The Admission of Forensic Science Evidence in Litigation	3-1
Law and Science	
The <i>Frye</i> Standard and Rule 702 of the Federal Rules of Evidence	
The <i>Daubert</i> Decision and the Supreme Court's Construction of Rule 702	
The 2000 Amendment of Rule 702	
An Overview of Judicial Dispositions of <i>Daubert</i> -Type Questions	
Some Examples of Judicial Dispositions of Questions Relating to Forensic Science Evidence	
Conclusion	
4 The Principles of Science and Interpreting Scientific Data	4-1
Fundamental Principles of the Scientific Method	
Conclusion	
5 Descriptions of Some Forensic Science Disciplines	5-1
Biological Evidence	
Analysis of Controlled Substances	
Friction Ridge Analysis	
Other Pattern/Impression Evidence: Shoeprints and Tire Tracks	
Toolmark and Firearms Identification	
Analysis of Hair Evidence	
Analysis of Fiber Evidence	
Questioned Document Examination	
Analysis of Paint and Coatings Evidence	

Analysis of Explosives Evidence and Fire Debris
Forensic Odontology
Bloodstain Pattern Analysis
An Emerging Forensic Science Discipline: Digital And Multimedia Analysis
Conclusions

6 Improving Methods, Practice, and Performance in Forensic Science **6-1**

Independence of Forensic Science Laboratories
Uncertainties and Bias
Reporting Results
The Need for Research
Conclusions and Recommendations

7 Strengthening Oversight of Forensic Science Practice **7-1**

Accreditation
Standards and Guidelines for Quality Control
Proficiency Testing
Certification
Oversight as a Requirement of Paul Coverdell Forensic Science Improvement Grants
Codes of Ethics
Conclusions and Recommendations

8 Education and Training in Forensic Science **8-1**

Status of Forensic Science Education
Challenges and Opportunities to Improve Forensic Science Education
Research as a Component of Forensic Science Education Programs
Status of Training
Education in the Legal System
Conclusions and Recommendation

9 Medical Examiner and Coroner Systems: Current and Future Needs **9-1**

Medical Examiners and Coroners (ME/C)
ME/C Jurisdiction
ME/C Missions
Variations in ME/C Systems
Qualifications of Coroners and Medical Examiners
ME/C Administration and Oversight
ME/C Staffing and Funding
The Movement to Convert Coroner Systems to Medical Examiner Systems
Utilization of Best Practices
Potential Scientific Advances that May Assist ME/Cs
The Shortage of Medical Examiners and Forensic Pathologists
Standards and Accreditation for Death Investigation Systems
Quality Control and Quality Assurance
Continuing Medical Education
Homeland Security
Forensic Pathology Research

Common Methods of Sample and Data Collection
Conclusions and Recommendation

10 Automated Fingerprint Identification Systems **10-1**

Interoperability Challenges
Conclusions and Recommendation

11 Homeland Security and the Forensic Science Disciplines **11-1**

Conclusions and Recommendation

Appendices

A Biographical Information of Committee and Staff **A-1**

B Committee Meeting Agendas B

