Boston University Forensic Sciences Symposium

Boston, MA

April 10, 2015

Recent NIST Activities to Strengthen Forensic Science

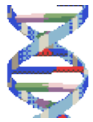
John M. Butler, Ph.D.

NIST Fellow & Special Assistant to the Director for Forensic Science

National Institute of Standards and Technology

Gaithersburg, Maryland

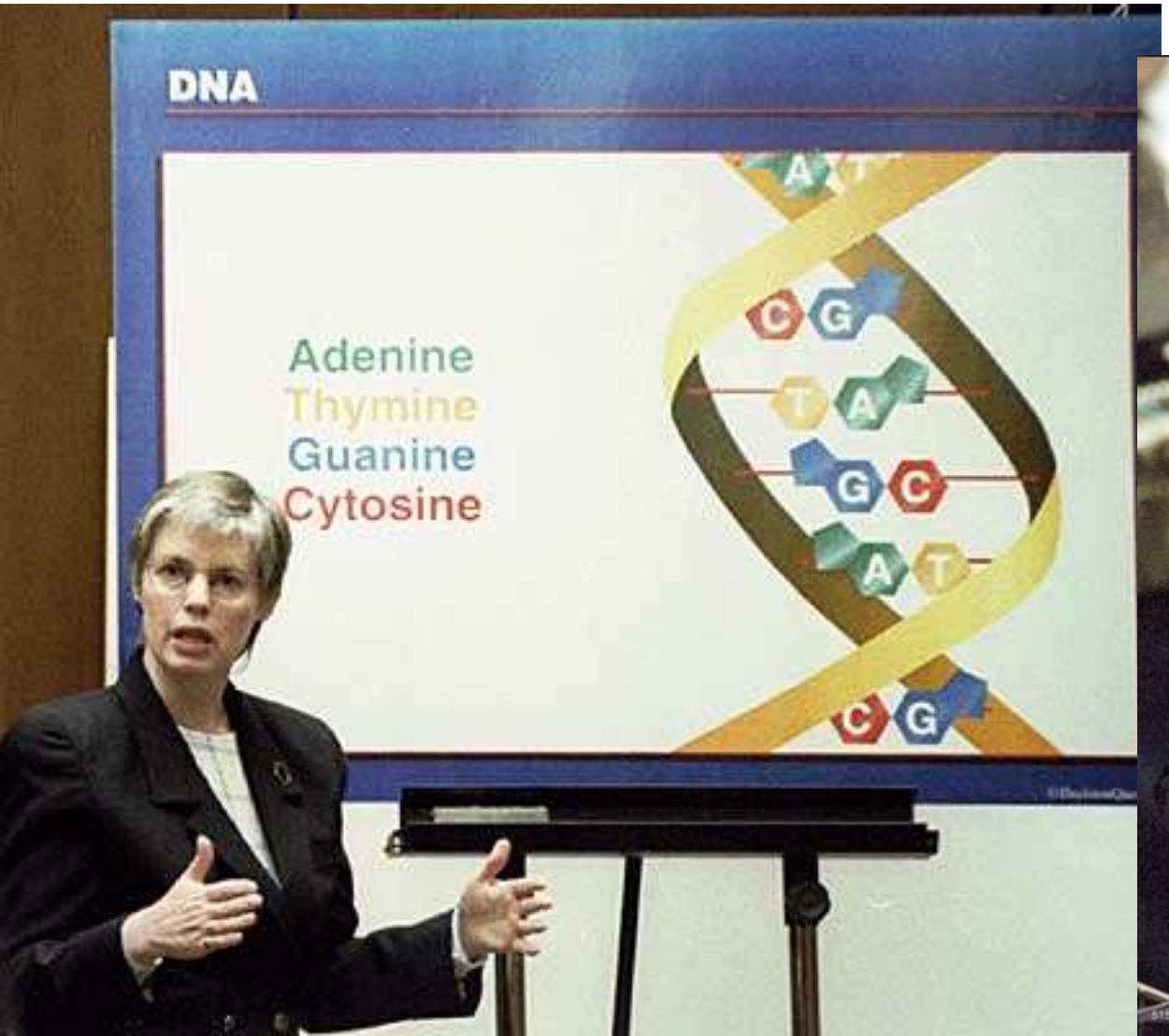
NIST FORENSIC SCIENCES



NIST

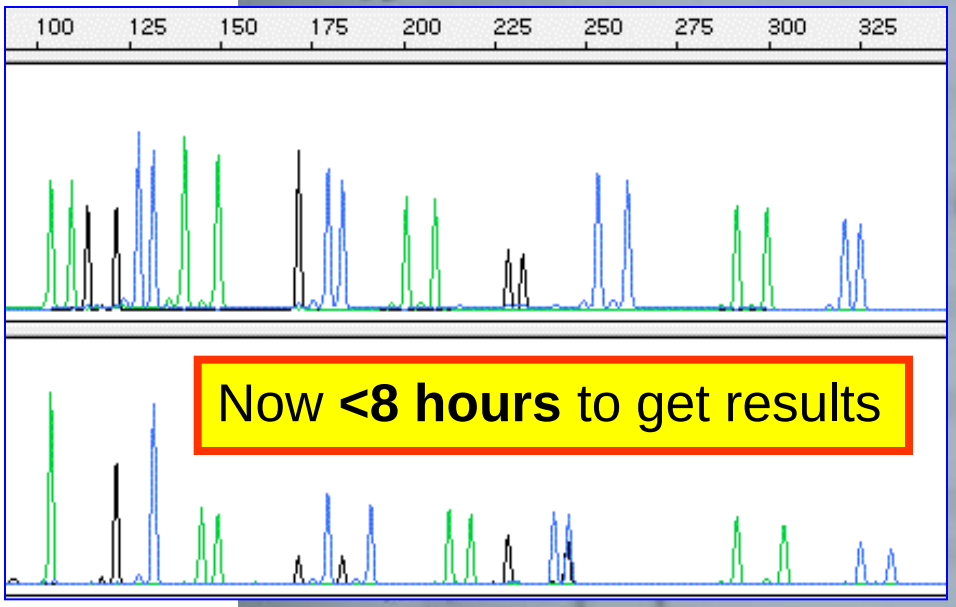
The World's Largest Classroom

Dr. Robin Cotton in May 1995 teaches >1 billion people watching the O.J. Simpson Trial about DNA



Progress Since 1995…

Almost **8 weeks** needed to get results

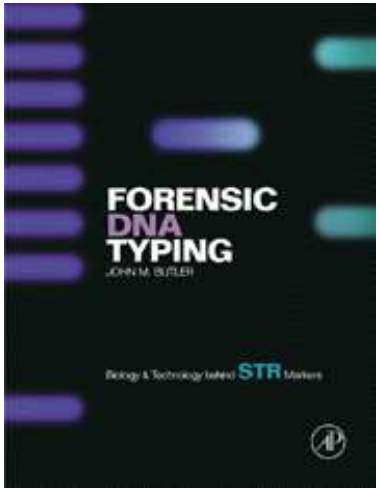


Now **<8 hours** to get results

O.J. Simpson DNA testing was performed with RFLP

Forensic DNA Typing Textbooks Have Set the Standard for the Field

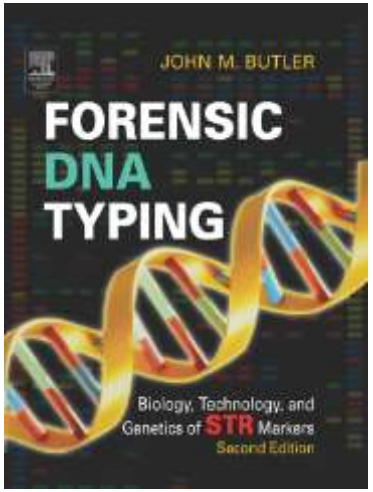
1st Edition



Jan 2001

335 pages

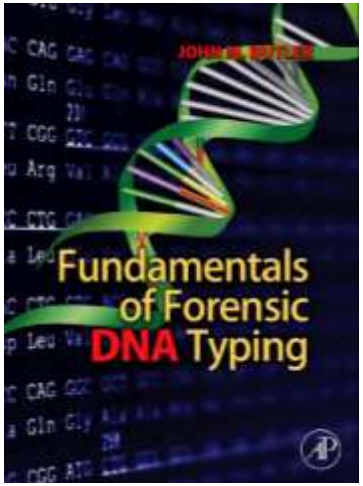
2nd Edition



Feb 2005

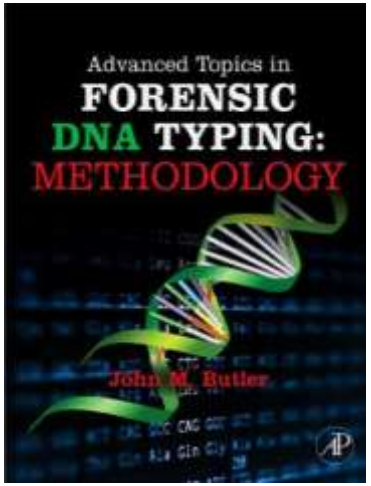
688 pages

3rd Edition (3 volumes)



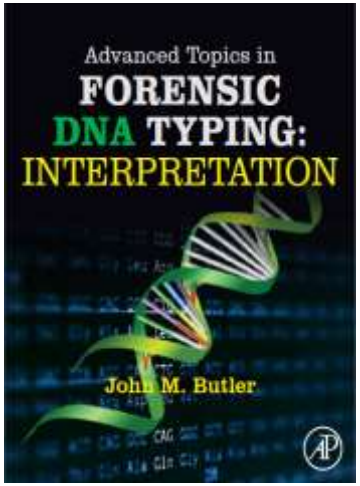
Sept 2009

520 pages



Aug 2011

704 pages

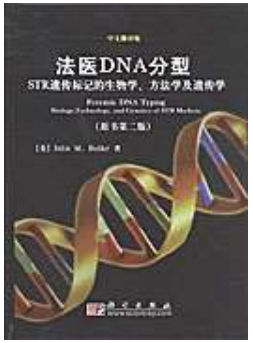


Oct 2014

604 pages

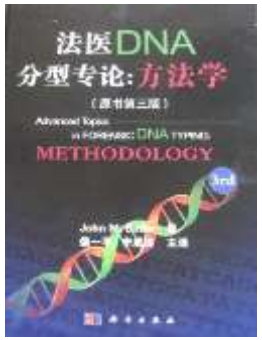
Language Editions

Chinese (2007)



Japanese (2009)

Chinese (2013)



Greg Matheson on Forensic Science Philosophy

The CAC News – 2nd Quarter 2012 – p. 6
"Generalist vs. Specialist: a Philosophical Approach"
http://www.cacnews.org/news/2ndq12.pdf

- If you want to be a technician, performing tests on requests, then just focus on the policies and procedures of your laboratory. If you want to be a scientist and a professional, learn the policies and procedures, but go much further and learn the philosophy of your profession. **Understand the importance of why things are done** the way they are done, the scientific method, the viewpoint of the critiques, the issues of bias and the importance of ethics.

Background Information on NIST

- Started in 1901 with roots back to the Constitution
- Name changed to **National Institute of Standards and Technology (NIST)** from National Bureau of Standards in 1988
- Primary campus in Gaithersburg, Maryland (just outside of Washington, D.C.)
- Part of the U.S. Department of Commerce
- >3,000 employees and >2,000 associates
- Supply >1300 reference materials
- Defines official time for the U.S.

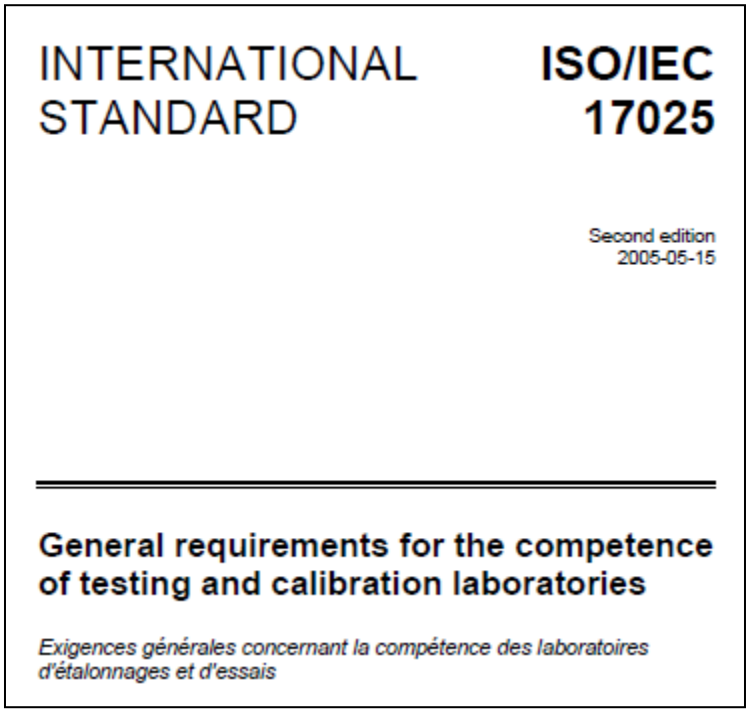
Types of Standards

physical (measurement) standards

Certified reference material to aid with calibration of measurements

http://www.nist.gov/srm/

documentary (technical) standards


INTERNATIONAL STANDARD

ISO/IEC 17025

Second edition
2005-05-15

General requirements for the competence of testing and calibration laboratories

Exigences générales concernant la compétence des laboratoires d'étalonnages et d'essais

Specific requirements for the operation of a laboratory related to management system and competence

U.S. Innovation Agenda – NIST has an increasing role

Examples of NIST Programs Addressing National Priorities:

- Advanced Communications
- Advanced Manufacturing
- Climate Assessment
- Cybersecurity
- Energy
- **Forensic Science**
- Healthcare
- Nanotechnology

NIST's Early History in Forensic Science Research

- **1913** - Wilmer Souder was asked to calibrate some precision measuring devices sent to him by famed handwriting expert Albert Osborn.
- By the 1930s – Souder was recognized as a pioneer researcher in questioned documents, handwriting, typewriting, ballistics, and firearms.
- Souder was instrumental in setting up the FBI Laboratory, which opened in 1932

NIST began work with fingerprints in the 1960s and with DNA in the 1990s

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Co-lead with DOJ

National Commission on Forensic Science

NIST Point-of-Contact (POC): **John Butler**

A federal advisory committee for the U.S. Department of Justice

http://www.justice.gov/ncfs

Organization of Scientific Area Committees

POC: **Mark Stolorow & John Paul Jones**

NIST-administered effort dedicated to identifying and developing technically sound, consensus-based documentary standards and guidelines

http://www.nist.gov/forensics/osac/

NIST FORENSIC SCIENCES

NIST Forensic Research Program

NIST Forensic Science Center of Excellence (to be awarded FY15)

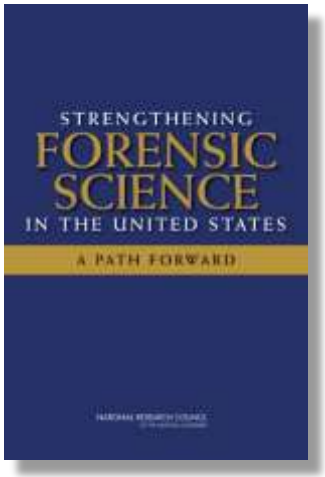
POC: **Sue Ballou**

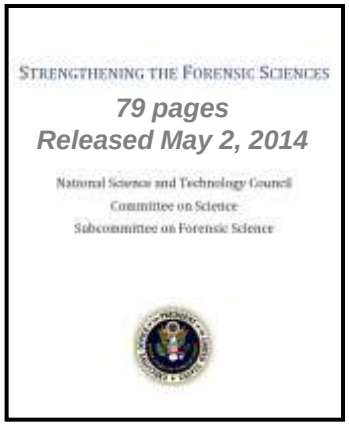
SIX FOCUS AREAS

1. ***Ballistics and Associated Tool Marks***
2. ***Digital and Identification Forensics***
3. ***Forensic Genetics***
4. ***Toxins***
5. ***Trace***
6. ***Statistics***

http://www.nist.gov/forensics

NCFS and OSAC:
U.S. Efforts to Strengthen Forensic Science





http://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/strengthening_the_forensic_sciences_may_-_2014.pdf

- National Academy of Sciences **(NAS) report** issued in Feb 2009
- White House **Subcommittee on Forensic Science** (SoFS) operated from July 2009 to Dec 2012

DOJ/NIST Partnership (announced Feb 2013)

1. **NCFS** (National Commission on Forensic Science)
   - **First meeting held February 3-4, 2014 in Washington DC**
2. **OSAC** (Organization of Scientific Area Committees)
   - **542 members named; first public meetings held in Feb 2015**

National Commission on Forensic Science

A Federal Advisory Committee
for the U.S. Department of Justice

NIST
National Institute of Standards and Technology

http://www.justice.gov/ncfs

National Commission on Forensic Science (NCFS)

31 voting and 8 *ex-officio* members

Last meeting (5th): January 29-30, 2015

Next meeting (6th): April 30-May 1, 2015

Policy-focused

NCFS Leadership

Sally Q. Yates
Acting
Deputy Attorney General
DOJ Co-Chair

Willie E. May
Acting
Director of NIST
NIST Co-Chair

Nelson A. Santos
Vice-Chair (DOJ)

John M. Butler
Vice-Chair (NIST)

Vice-Chairs of the National Commission on Forensic Science: John Butler (NIST) and Nelson Santos (DOJ)

Photo taken before our AAFS 2015 talk regarding the National Commission on Forensic Science

February 3-4, 2014 was the first meeting of the **National Commission on Forensic Science**

37 Commissioners + DOJ/NIST Leadership Team (with ~100 public attendees)

NCFS Membership: First Term (2013-2015)

- **31 voting and 8 ex-officio members**
  - Selected from >300 applicants
  - Represent diverse backgrounds, extensive experience, and come **from 21 states**

- Professors of biochemistry, chemistry, pathology, physics, sociology, statistics, and law (including a Nobel laureate and National Medal of Science recipient)
- Crime laboratory directors
- Judges, prosecutors, and defense attorneys
- Sheriff, detective, coroner, medical examiner, victims' advocate, and defendants' rights advocate

Current NCFS Subcommittees

http://www.justice.gov/ncfs/subcommittees

where much of the Commission work occurs…

	NCFS Subcommittee	# Commissioners	# Non-Commissioners
1.	**Accreditation & Proficiency Testing**	7	15
2.	**Human Factors & Cognitive Bias**	5	13+1
3.	**Interim Solutions**	12	2
4.	**Medico-legal Death Investigation**	6	9
5.	**Reporting & Testimony**	13	8
6.	**Scientific Inquiry & Research**	12	3
7.	**Training on Science & Law**	8	6

Most Commissioners are on multiple subcommittees

57 non-Commissioners contributing to the process

Subcommittee products are discussed and voted on by the full Commission prior to be recommended to the Attorney General

Organization of Scientific Area Committees (OSAC)

Forensic discipline-specific “guidance groups” administered by NIST

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

http://www.nist.gov/forensics/osac/index.cfm

Listing of Scientific Working Groups (SWGs) as of 2013

	Scientific Working Group (SWG)	Topic (Forensic Discipline)	Start	Sponsor	Website
1	**SWGDAM**	**DNA**	1988	FBI	swgdam.org
2	SWGMAT	Materials (Trace)	1992	FBI	swgmat.org
3	SWGFAST	Friction Ridge (Fingerprints)	1995	FBI	swgfast.org
4	**SWGDRUG**	**Controlled Substances**	1997	DEA	swgdrug.org
5	SWGIT	Imaging Technologies	1997	FBI OTD	swgit.org
6	SWGDOC	Document Examination	1997	FBI	swgdoc.org
7	**SWGDE**	**Digital Evidence**	1998	FBI OTD	swgde.org
8	SWGGUN	Firearms & Toolmarks	1998	FBI	swggun.org
9	SWGFEX	Fire Debris & Explosives	1998	**NIJ**	swgfex.org
10	SWGSTAIN	Bloodstain Pattern	2002	**NIJ**	swgstain.org
11	SWGTREAD	Shoeprint & Tire Tread	2004	FBI	swgtread.org
12	SWGDOG	Dog & Orthogonal Detector	2004	FBI	swgdog.fiu.edu
13	SWGGSR	Gun Shot Residue	2007	**NIJ**	swggsr.org
14	SWGANTH	Anthropology	2008	FBI	swganth.org
15	SWGTOX	Toxicology	2009	**NIJ**	swgtox.org
16	FISWG	Facial Identification	2009	FBI OTD	fiswg.org
17	SWGDVI	Disaster Victim Identification	2010	FBI	swgdvi.org
18	SWGMDI	Medicolegal Death Investigation	2010	**NIJ**/FBI	swgmdi.org
19	SWGGEO	Geological Materials	2011	USACIL	swggeo.org
20	SWGWILD	Wildlife Forensics	2011	USFWS	wildlifeforensicscience.org/swgwild
21	SWGSPEAKER	Voice Analysis	2012	FBI	swg-speaker.org

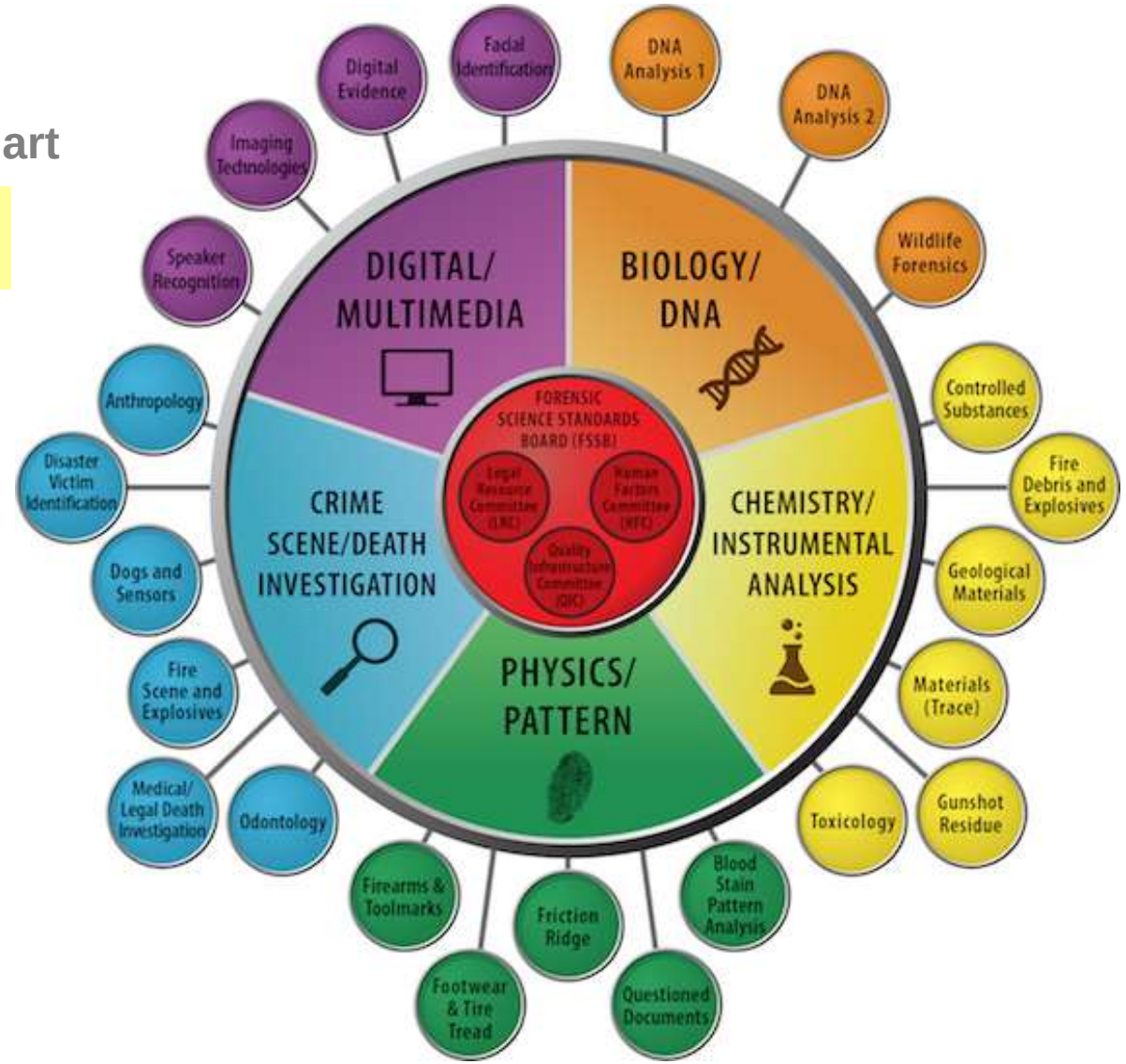
Organization of Scientific Area Committees

OSAC

Functional Organization Chart

Practice-focused

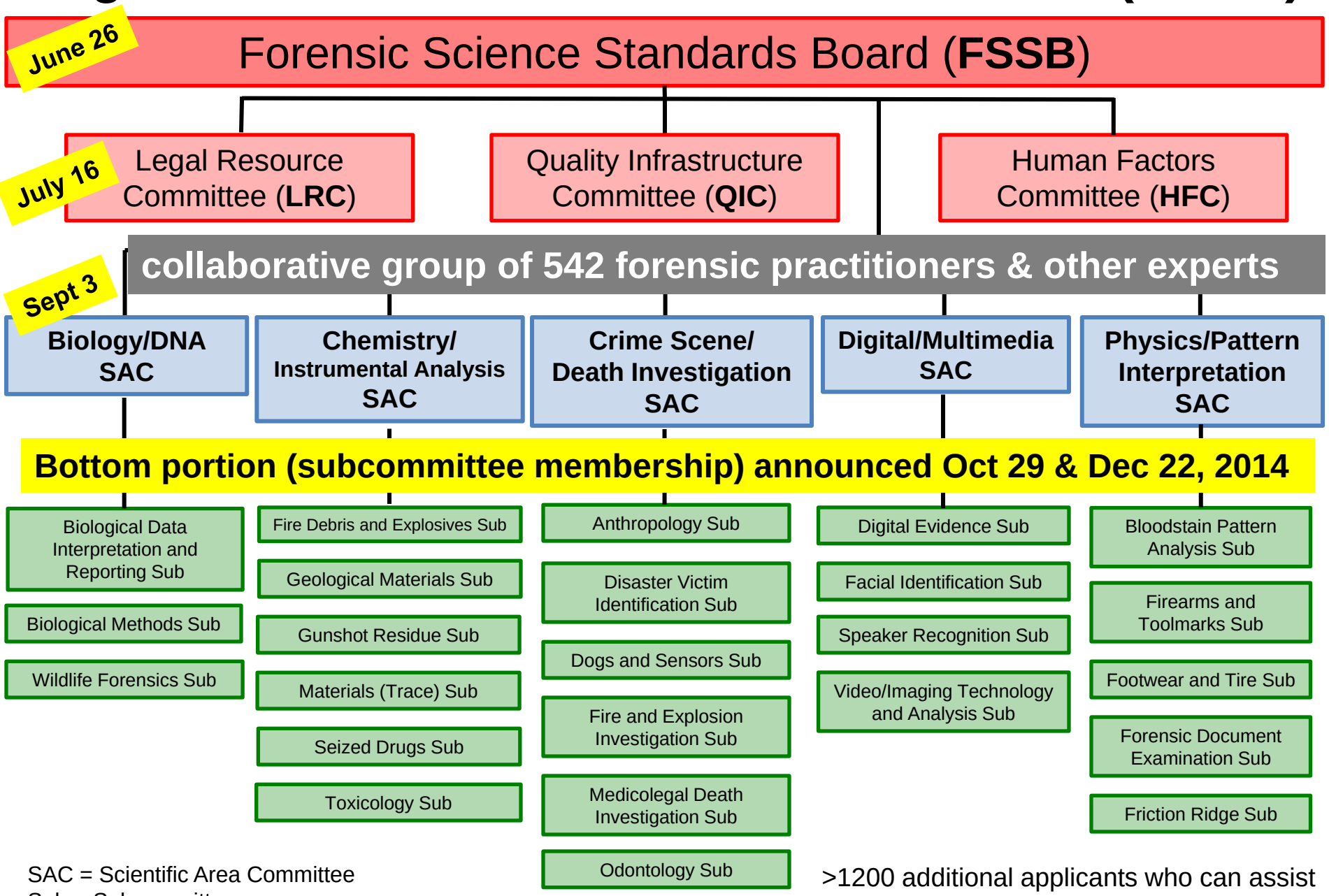
542 members and >1200 affiliates
as subject matter experts participating in 24 subcommittees, 5 scientific areas, 3 resource committees (legal, quality, human factors), and 1 governing board (Forensic Science Standards Board)



http://www.nist.gov/forensics/osac/index.cfm

Initial membership finalized Dec 22, 2014

Organization of Scientific Area Committees (OSAC)



SAC = Scientific Area Committee
Sub = Subcommittee

>1200 additional applicants who can assist with task group efforts as OSAC affiliates

Understanding the OSAC Levels

Forensic Science Standards Board (FSSB)

- Set policy, rules, priorities for OSAC
- Manage OSAC Registry of Approved Standards and Approved Guidelines

Legal Resource, Quality Infrastructure, Human Factors Committees

- Provide advice across all forensic science and discipline committees

Scientific Area Committees

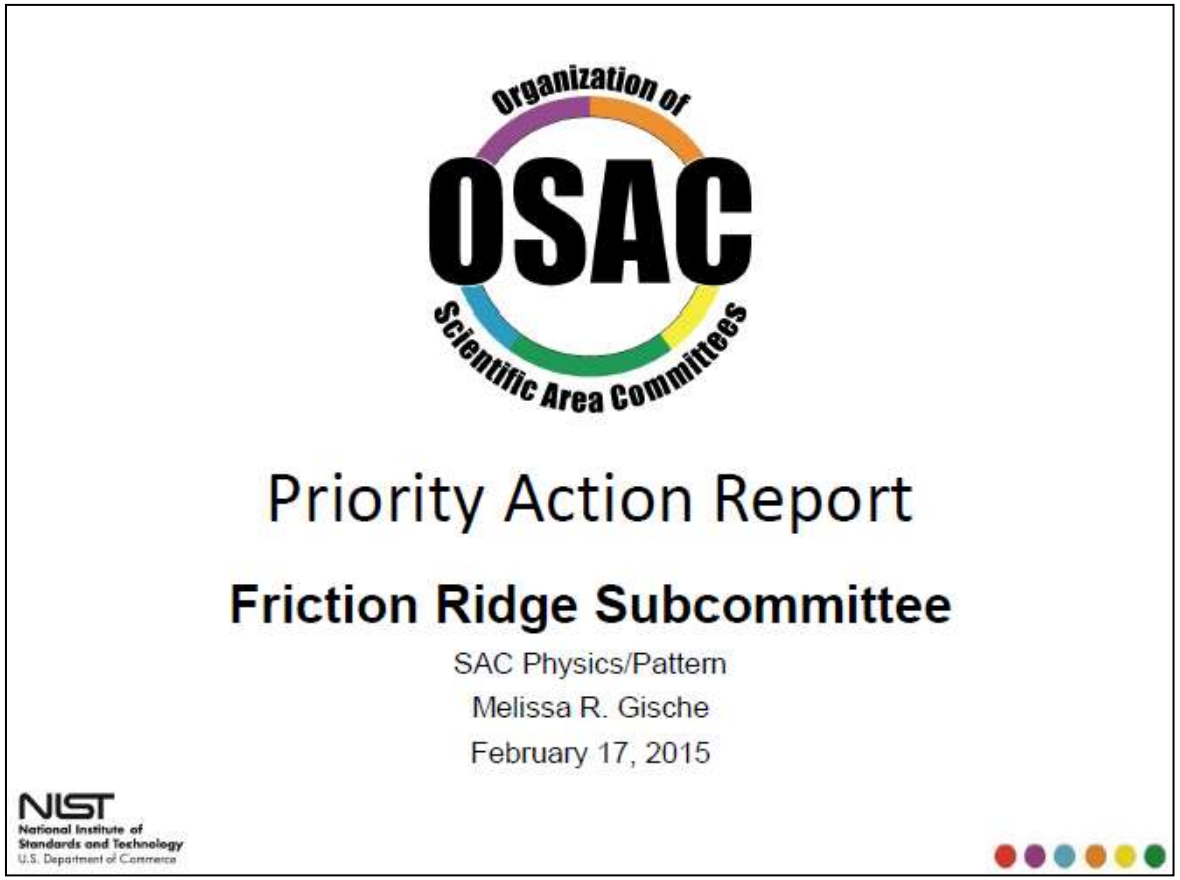
- Manage work within a scientific area (harmonize/leverage across related disciplines)
- Adopt and approve scientific area standards, (e.g., terminology, reporting requirements, conclusion statements)

Discipline Specific Subcommittees (Working Groups)

- Identify and develop (with an SDO or the canvass method) standards & guidelines for discipline

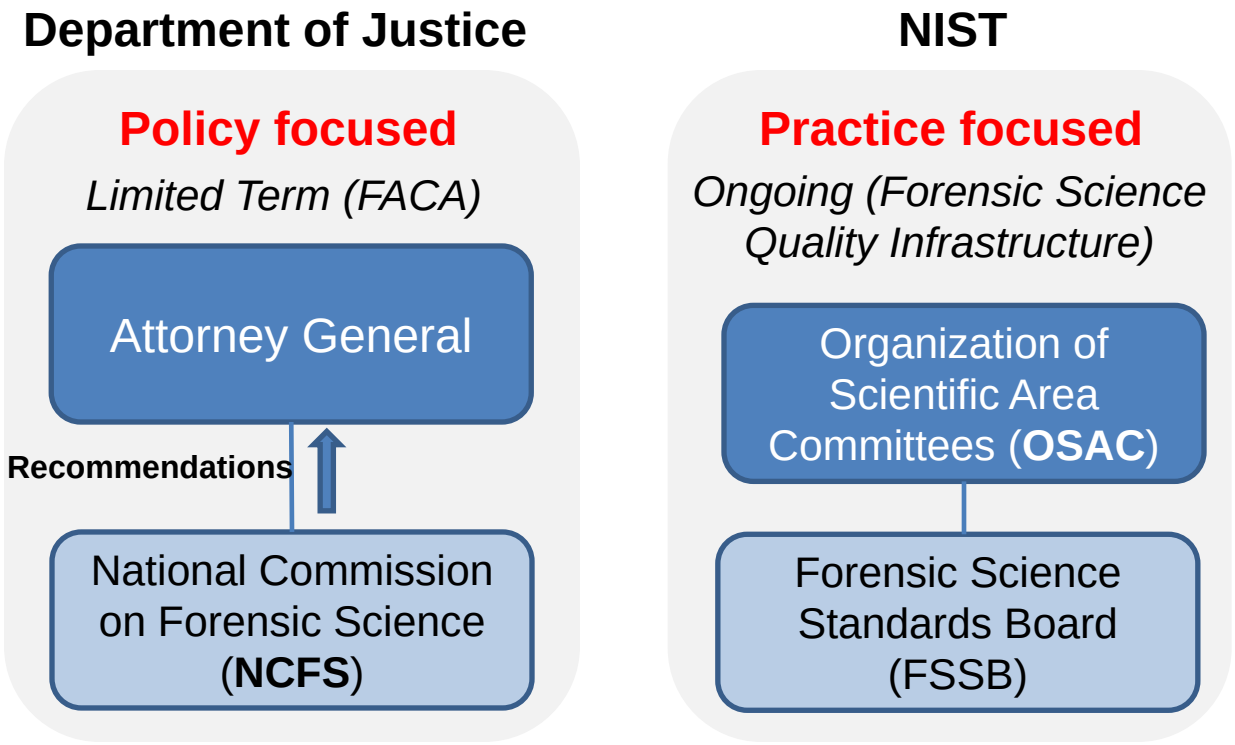
OSAC Scientific Area Committee Public Meetings held February 16-17, 2015 in Orlando, FL

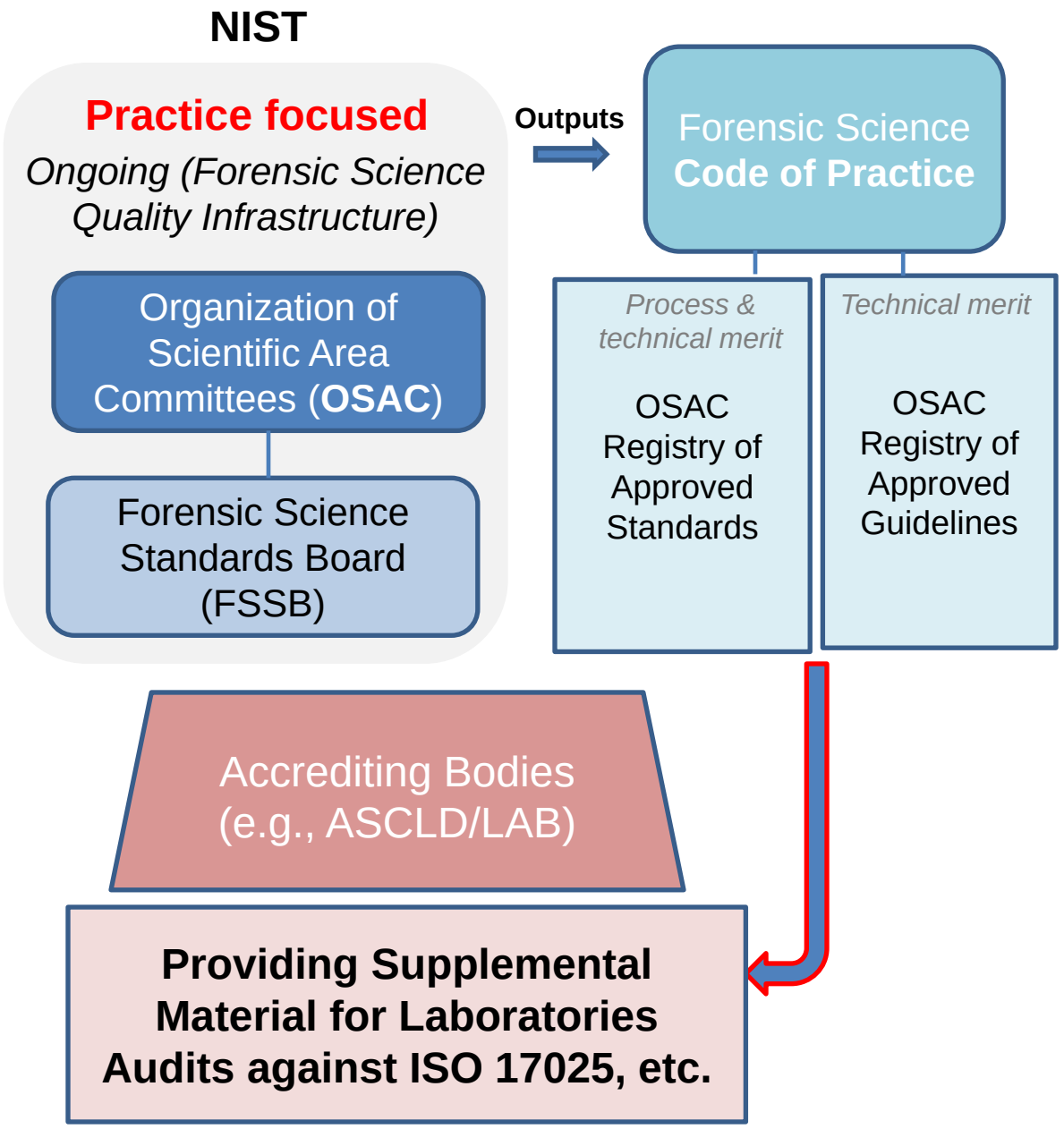
1 of 30 presentations that can be downloaded



- This friction ridge subcommittee presentation contains 27 slides
- Reviews subcommittee leadership, membership, priority topics, and task groups

https://workspace.forensicosac.org/kws/public


Department of Justice
Policy focused
Limited Term (FACA)
Attorney General
Recommendations
National Commission on Forensic Science (NCFS)
NIST
Practice focused
Ongoing (Forensic Science Quality Infrastructure)
Organization of Scientific Area Committees (OSAC)
Forensic Science Standards Board (FSSB)


NIST
Practice focused
Ongoing (Forensic Science Quality Infrastructure)
Organization of Scientific Area Committees (OSAC)
Forensic Science Standards Board (FSSB)
Outputs
Forensic Science Code of Practice
Process & technical merit
OSAC Registry of Approved Standards
Technical merit
OSAC Registry of Approved Guidelines
Accrediting Bodies (e.g., ASCLD/LAB)
Providing Supplemental Material for Laboratories Audits against ISO 17025, etc.

Overview of Standards involved in the Forensic Science Enterprise

ILAC-G19:08/2014
Modules in a Forensic Science Process

ISO/IEC **17024**
Certification Provider

ISO/IEC **17043**
Proficiency Test Provider

ISO/IEC **17011**
Accrediting Body

Forensic Testing Laboratory

Technical standard: ISO/IEC **17025**

Supplemental material: DNA (QAS) | Latents | Firearms | …

Police Agency

ISO/IEC **17020**

Crime scene unit

M.E./Coroner

ISO **15189**

Autopsy | Virtopsy

OSAC work will help provide supplemental materials and new technical standards

Accreditation to appropriate quality standards should provide confidence for all stakeholders in what is being done

NIST Forensic Science Research

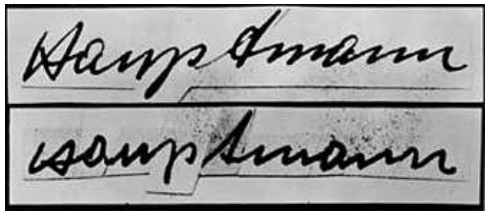
NIST Forensic Science Research Efforts

Assisting the forensic science community through:

- Scientific and technical advances
- New analytical tools and supporting infrastructure
- Scientific validation of currently applied instrumentation and methods
- Evaluation of models, methods, and standards
- Performance and validation studies to define and estimate error rates

Dr. Wilmer Souder and Early Forensic Work at NBS/NIST

- Connected with Albert S. Osborn ("Questioned Documents") **in 1913** and worked on forensics issues for the 20 years leading up to the establishment of the FBI Laboratory.
- **Consulted on the formation of the FBI Laboratory when it was established in 1932**
- Worked on:
  - **"Black Tom" Sabotage**: German agents caused an American munitions shipment bound for Europe to explode in New York harbor in 1916. In the early 1930s, Souder analyzed a handwritten letter from one of the agents, a critical piece of evidence in the case that eventually forced Germany to pay the United States for damages.
  - **The Lindbergh kidnapping**: In 1935, Souder's testimony on handwriting samples was key to convicting Richard Hauptmann in the kidnapping and murder of Charles Lindbergh's son.



  - **Forgeries, Stolen Securities, Extortion, Threatening Letters, Raised Checks…**

Forensics at NIST

NIST has a long and rich history of work in support of law enforcement

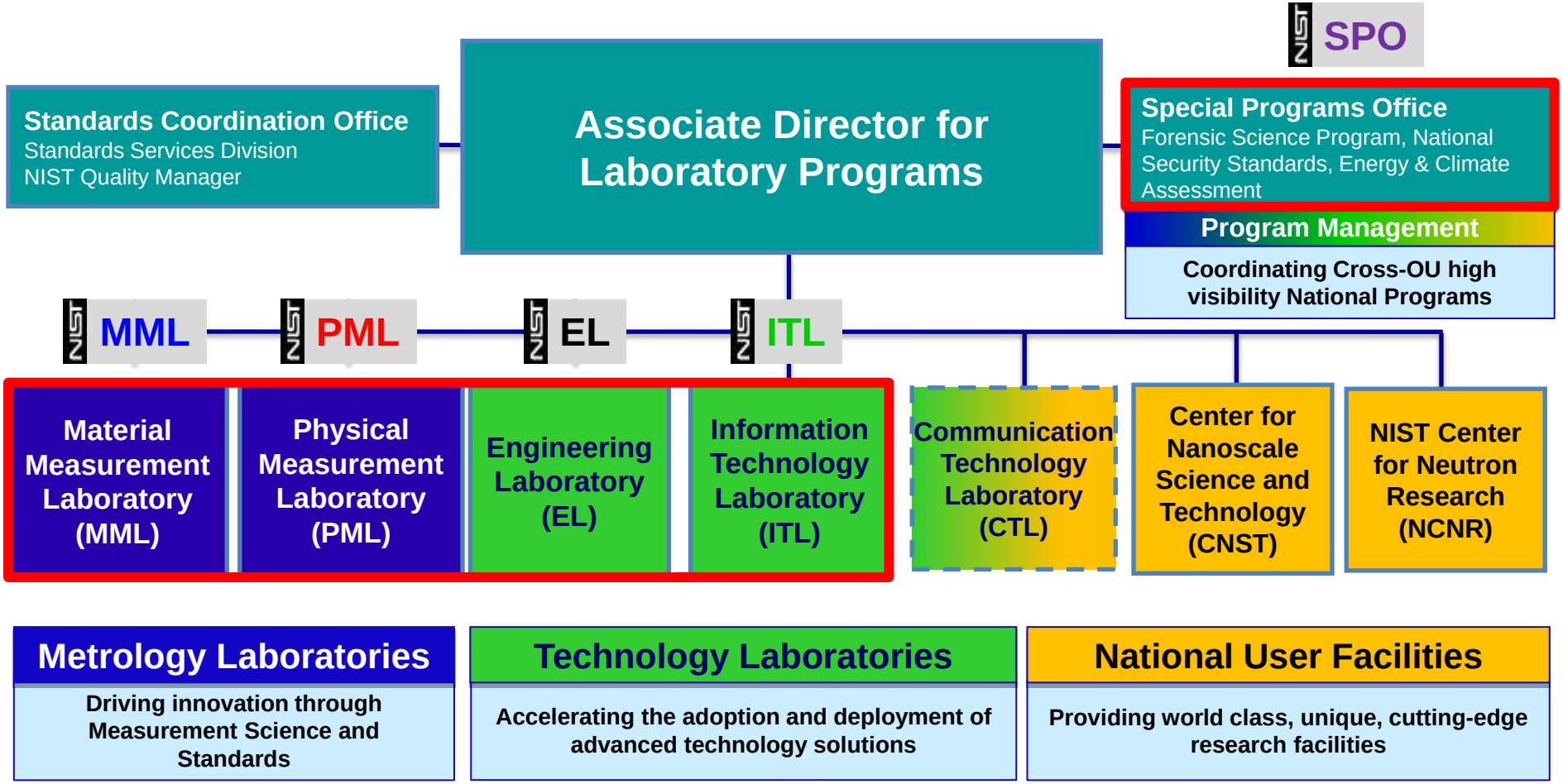
Currently providing research and measurement services such as validated test methods, Standard Reference Materials, and Reference Data in areas such as:

- crime scene investigations
- computer forensics
- fire investigations
- drug detection
- drunk driving testing
- biometrics (fingerprints and handwriting analysis)
- firearms/ballistics
- standards for body armor, nonlethal weapons
- explosives detection technologies
- sports integrity/fairness
- genetics and DNA-based identification

Support the Departments of Defense, Justice, and Homeland Security in carrying out their programs

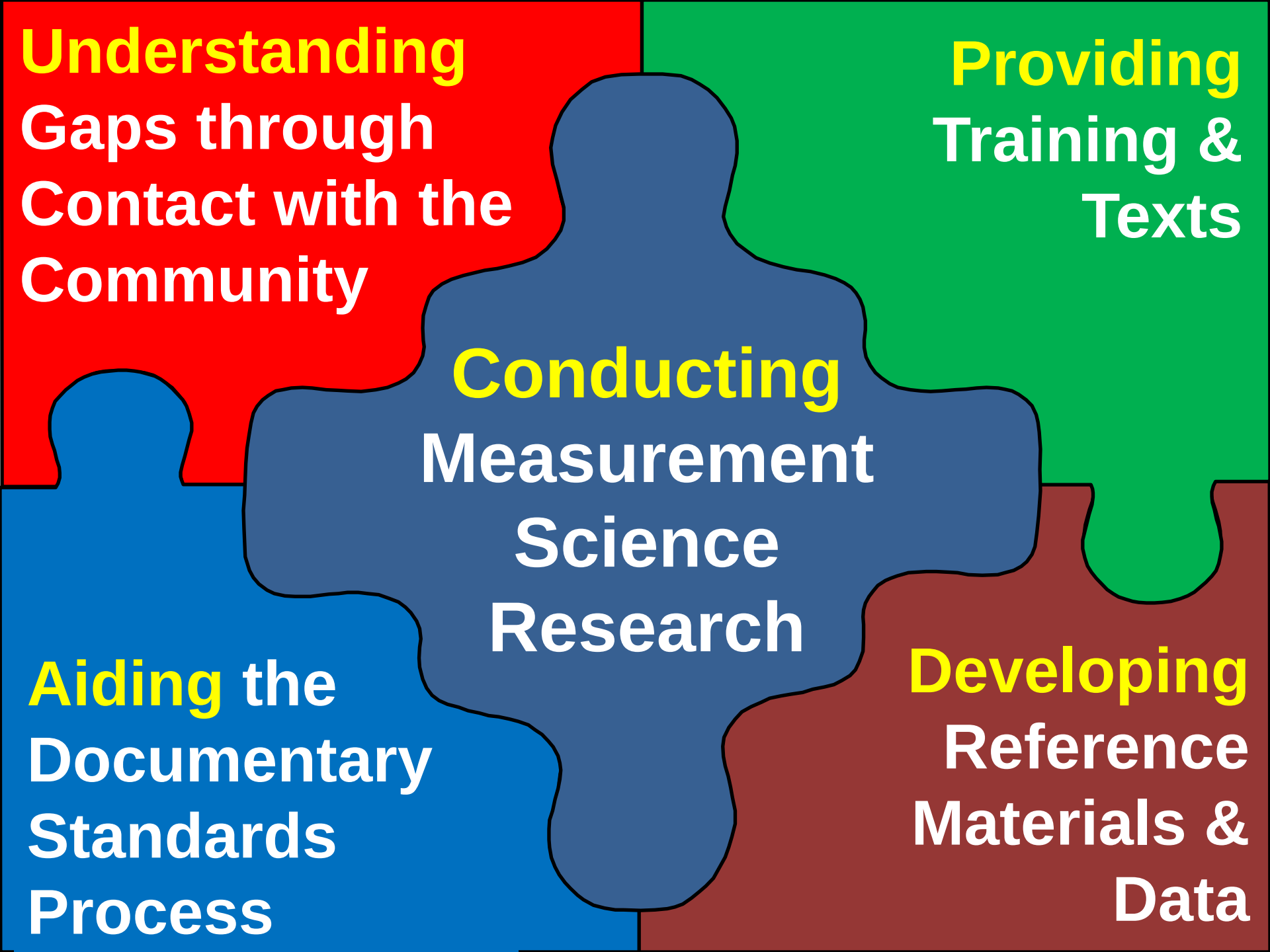
NIST Laboratory Program

providing measurement solutions for industry and the nation



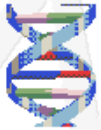
Current NIST Program Areas in Forensic Science Research

1. ITL — Digital (Computer Forensics)
2. MML — DNA (Forensic Genetics)
3. PML — Ballistics/Toolmarks
4. ITL — Statistical Measurements
5. MML — Toxins (Drug Analysis)
6. MML — Trace Evidence Measurements


Understanding
Gaps through
Contact with the
Community
Providing
Training &
Texts
Conducting
Measurement
Science
Research
Aiding the
Documentary
Standards
Process
Developing
Reference
Materials &
Data

NIST **STRBase** Website

Serving the Forensic DNA Community for Almost 20 Years



Short Tandem Repeat DNA

Internet DataBase

NIST Standard Reference Database SRD 130 [Recent Updates]

Serving the forensic DNA and human identity testing communities for over 10 years... **These data are intended to benefit research and application of short tandem repeat DNA markers to human identity testing. The authors are solely responsible for the information herein.**
Please Rate Our Products and Services: http://tsapps.nist.gov/MSDSurvey/default.aspx?ID=5&DB=130

This database has been accessed 458551 *times since 10/02/97.* (Counter courtesy www.digits.com - see disclaimer)

Created by ***John M. Butler***
and Dennis J. Reeder (NIST Biochemical Science Division),
with invaluable help from Jan Redman, Christian Ruitberg and Michael Tung
Site creators' curriculum vitaes available using links above.

Partial support for the design and maintenance of this website is being provided by The National Institute of Justice through the NIST Office of Law Enforcement Standards.

General Information

- Purpose of STRBase/NAR 2001 Paper describing STRBase/Overview Presentation
- Publications and Presentations from NIST Human Identity Project Team
- NIJ-Funded Projects
- Training Materials
- Links to other web sites
- Glossary of commonly used terms

http://www.cstl.nist.gov/strbase/

U.S. is Moving to 20 Core Loci

Locus
CSF1PO
D3S1358
D5S818
D7S820
D8S1179
D13S317
D16S539
D18S51
D21S11
FGA
TH01
TPOX
vWA
D1S1656
D2S441
D2S1338
D10S1248
D12S391
D19S433
D22S1045

Red is for original CODIS Core 13 Loci.
Blue is for new additional CODIS Core Loci.

Forensic Science International: Genetics 17 (2015) 33–34

Contents lists available at ScienceDirect

Forensic Science International: Genetics

journal homepage: www.elsevier.com/locate/fsig

Letter to the Editor

Selection and implementation of expanded CODIS core loci in the United States

"The CODIS Core Loci Working Group selected a consortium of 11 CODIS laboratories…these laboratories performed validation experiments…

With the assistance of the National Institute of Standards and Technology (NIST), the data generated through these validation studies were compiled, reviewed and analyzed."

Hares, D.R. (2015) Selection and implementation of expanded CODIS core loci in the United States. *Forensic Sci. Int. Genet.* 17:33-34

Three major reasons for expanding the CODIS core loci in the United States

D.R. Hares (2012) *Forensic Sci. Int. Genet.* 6(1):e52-e54

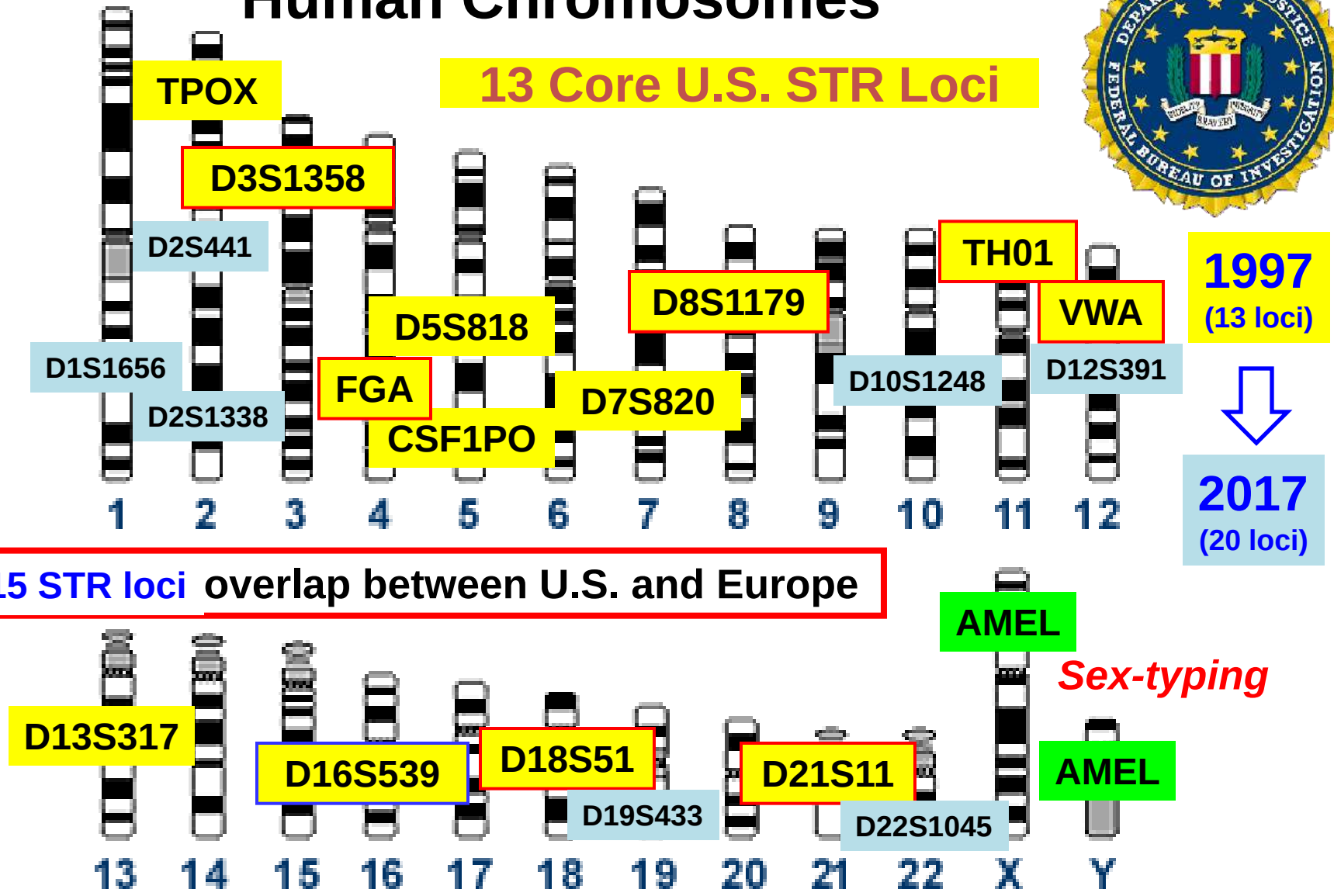
- **To reduce the likelihood of adventitious matches** as the number of profiles stored at NDIS continues to increase each year

- **To increase international compatibility** to assist law enforcement data sharing efforts

- **To increase discrimination power to aid missing persons cases**

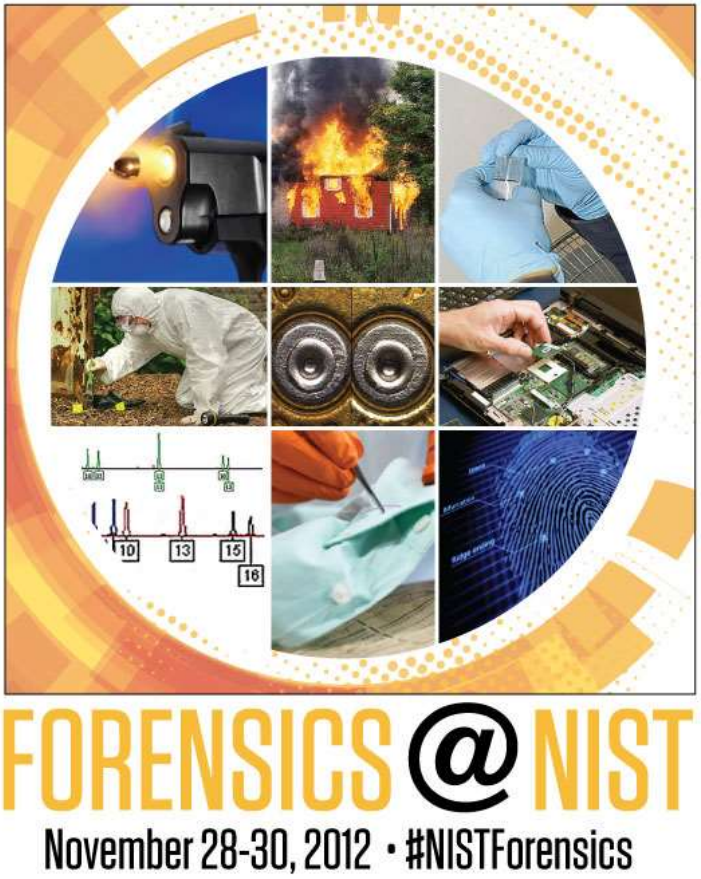
Position of Forensic STR Markers on Human Chromosomes

Core STR Loci for the United States



NIST FORENSIC SCIENCES

Biannual Conference to Showcase NIST Research



November 28-30, 2012 at NIST

- **52 presentations** covering DNA, firearms and toolmarks, fire research, trace sampling, drug analysis, computer and multimedia forensics, fingerprints, facial and speaker recognition
- >500 registered; in addition to on-site participation, the event was webcast
- Presentations and video are available for downloading and viewing

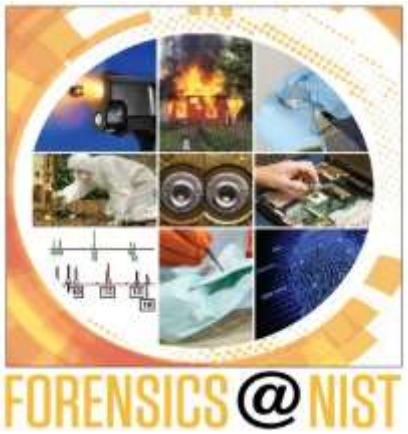
December 3-4, 2014 at NIST

- 20 presentations
- 30 posters

http://www.nist.gov/oles/forensics-2012.cfm

http://www.nist.gov/forensics/forensics-at-nist-2014.cfm

Forensic Conferences Held at NIST



2012: Nov. 28-30
2014: Dec. 3-4

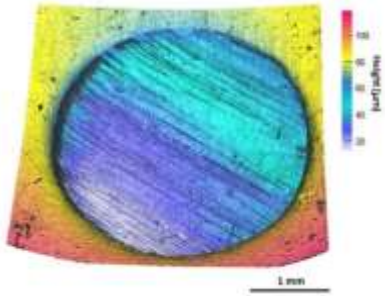
June 18, 2014

NIST FORENSIC SCIENCES | NIJ National Institute of Justice

January 26-27, 2015

March 24, 2014

Forensic Optical Topography Meeting
(with NIJ and RTI International)



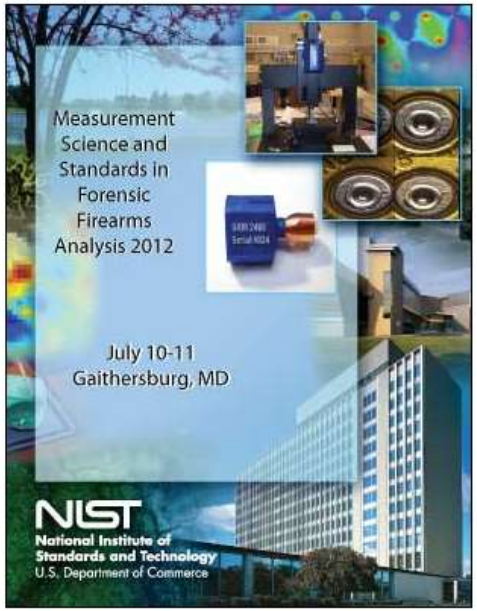
March 17-18, 2015

http://www.nist.gov/forensics/conferences_and_events.cfm

Conferences Held at NIST with Collaborators

Measurement Science and Standards in Forensic Firearms Analysis 2012

Purpose:



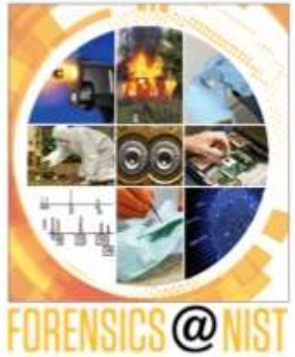
The National Institute of Standards and Technology (NIST) in collaboration with The Association of Firearm and Tool Mark Examiners (AFTE) and the Scientific Working Group for Firearms and Toolmarks (SWGGUN) hosted a two-day conference exploring measurement science and standards in the forensic discipline of firearms analysis.

July 10-11, 2012

Emerging Trends in Synthetic Drugs Workshop

Purpose:

The **National Institute of Standards and Technology (NIST)** in collaboration with the **Drug Enforcement Administration (DEA)** hosted a free two-day workshop and live webcast exploring emerging trends in the forensic analysis of synthetic cannabinoids, substituted cathinones, and novel hallucinogens.



April 30 - May 1, 2013

Measurement Science and Standards in Forensic Handwriting Analysis

June 4-5, 2013

DNA Mixture Interpretation
April 12, 2013 Webcast

http://www.nist.gov/oles/forensics/dna-analyst-training-on-mixture-interpretation.cfm

- **8-hours of DNA mixture interpretation training**
- **11 presentations** from **five different presenters**
  - John Butler, Mike Coble, Robin Cotton, Bruce Heidebrecht, Charlotte Word
- **20 poll questions** asked via SurveyMonkey (>600 participated)
  - Addressed additional questions sent via email or Twitter
- **>1000 participants** (almost entire U.S. represented and >10 countries)
- **Available for viewing or download** for at least six months (storage costs may limit longer-term storage)

Left to right:
Gladys Arrisueno (NIST, Twitter feed monitor & poll questions)
John Paul Jones (NIST, webcast organizer)
Mike Coble (NIST, presenter)
John Butler (NIST, presenter & organizer)
Charlotte Word (Consultant, presenter)
Robin Cotton (Boston University, presenter)
Bruce Heidebrecht (Maryland State Police Lab, presenter)

An Example of Direct Impact to Practice:

Latent Print Examination and Human Factors Report

NIJ award to NIST: 2008-DN-R-121 and 2010-DN-R-7121

- February 2012 report from the Expert Working Group on Human Factors in Latent Print Analysis
- Input from **64 contributors** and **11 reviewers**
- Provides **34 recommendations** and **detailed process maps**
- **Has directly influenced change in laboratory processes and reports from the FBI Laboratory and others**

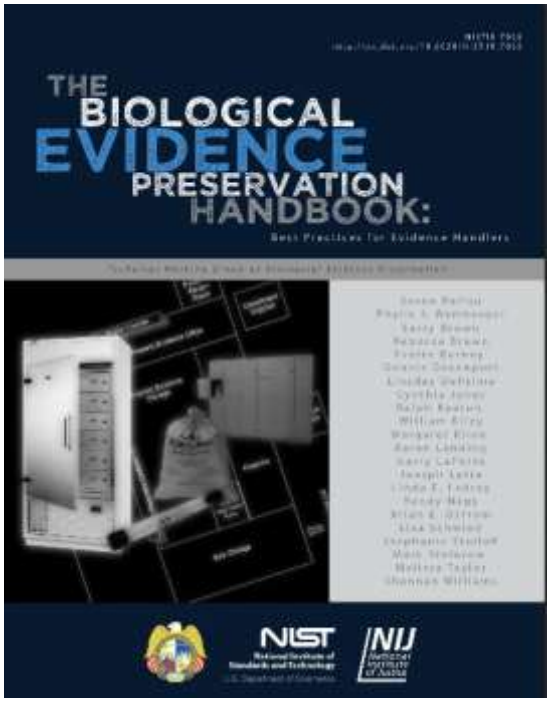
12 MB pdf file (249 pages) available from
http://www.nist.gov/forensics/publications.cfm

Other Recent NIST/NIJ Publications

http://www.nist.gov/forensics/publications.cfm

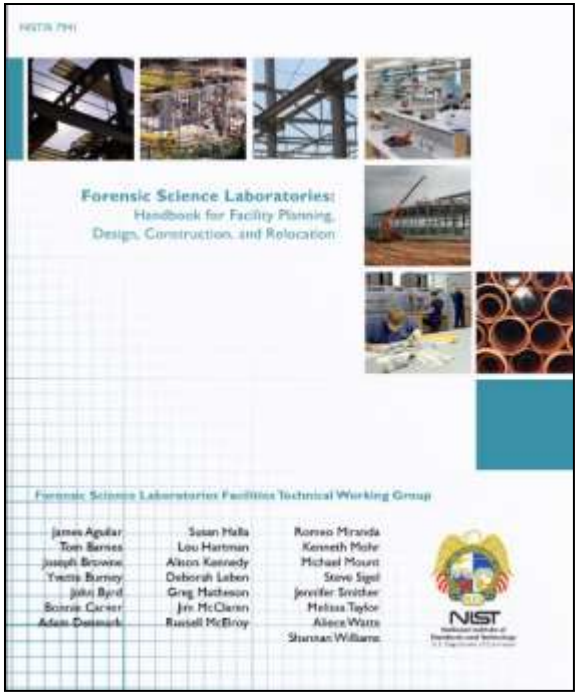
- Biological Evidence Preservation Handbook (2013)
- Forensic Lab Construction (2013)
- Crime Scene Investigation (2013)

Free pdf documents available



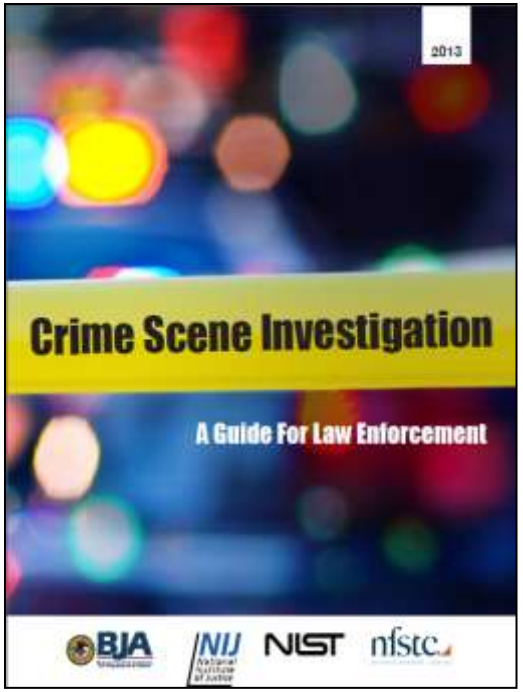
73 pages

NIJ award to NIST: 2010-DN-R-7121



98 pages

NIJ award to NIST: 2010-DN-R-7121



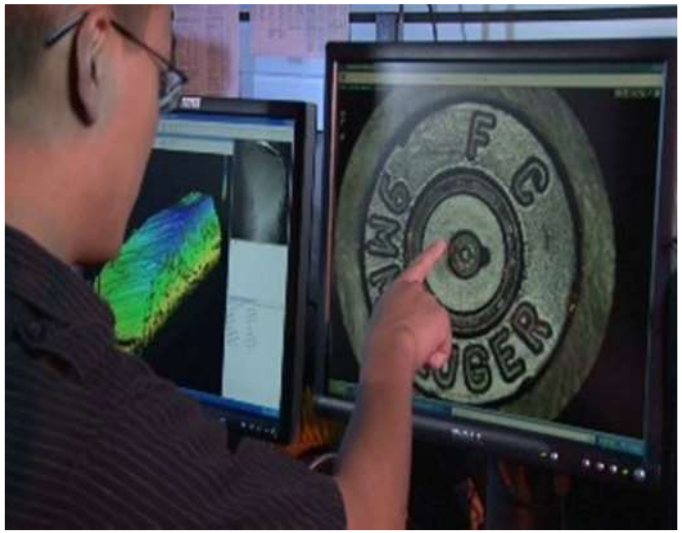
180 pages

NIJ award to NFSTC: 2007-MU-BX-K008

NIST Forensic Science Center of Excellence

Focus and Status

- This new Center of Excellence will focus on **developing probabilistic methods** to support the forensic science disciplines **with a focus on Pattern Evidence** and **Digital Evidence**
- Center will also focus on **developing training tools for practitioners and non-practitioners**
- Solicitation was open from August 19 to December 11, 2014
- **NIST plans to make the award soon (Spring 2015)**
- For more information, see **http://www.nist.gov/coe/forensics/**



Credit: NIST

Credit: FBI

International Symposium on Forensic Science Error Management – Detection, Measurement and Mitigation

Abstract deadline extended to April 30

The technical program will cover eight tracks: ***death investigation, crime scene investigation, human factors, criminalistics, digital evidence, legal factors, quality assurance and laboratory management***. Each track will consist of plenary lectures, poster sessions and panel discussions.

Hilton Washington DC - Dupont Circle
1919 Connecticut Ave., NW, Washington, DC

http://www.nist.gov/director/international_forensics_home.cfm

National Commission on Forensic Science (NCFS):
www.justice.gov/ncfs

Organization of Scientific Area Committees (OSAC):
www.nist.gov/forensics/osac/index.cfm

NIST FORENSIC SCIENCES

www.nist.gov/forensics

301-975-4049 **john.butler@nist.gov**