

European Academy of Forensic Science

Stockholm, Sweden 3 June 2022

Are We On the Right Side of the Equation: Becoming Outcome-Focused Versus Process-Driven

John M. Butler, PhD

National Institute of Standards and Technology, USA



NIST Disclaimer

Points of view are mine and do not necessarily represent the official position or policies of the National Institute of Standards and Technology.

Certain commercial entities are identified in order to specify experimental procedures as completely as possible. In no case does such identification imply a recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that any of the entities identified are necessarily the best available for the purpose.





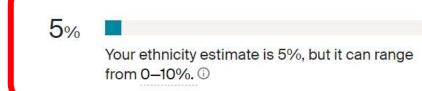
According to Ancestry DNA testing, I have some Swedish heritage...



| England & Northwestern Europe | 45% | > |
|-------------------------------|-----|---|
| Germanic Europe | 23% | > |
| Scotland | 15% | > |
| Sweden & Denmark | 5% | > |
| • Ireland | 5% | > |
| Norway | 3% | > |
| Eastern Europe & Russia | 2% | > |
| Benin & Togo | 1% | > |
| Basque | 1% | > |

Sweden & Denmark

Primarily located in: Denmark, Sweden Learn more about this map and ethnicity



Remnants of my (5%) Irish Ancestry...

The Butler Family Castle in Kilkenny, Ireland



https://www.butlerschocolates.com/en/about-us/our-heritage



- Original stone castle completed in 1213
- Purchased in 1391 by my 16th great-grandfather, James Butler, 3rd Earl of Ormond
- Butlers (my distant cousins) lived here until 1935
- Turned over to the people of Kilkenny in 1967 (to avoid increasing property taxes)



U.S. National Institute of Standards and Technology (NIST)

Science Agency (non-regulatory)

- Started in 1901 as the National Bureau of Standards (NBS) with roots back to the Constitution
- Name changed in 1988 to the National Institute of Standards and Technology (NIST)
- Primary campus in Gaithersburg, Maryland (just outside of Washington, D.C.)

 Partnering with Researchers
- In U.S. Department of Commerce
- >6,000 employees and associates
- Supplies >1300 reference materials
- Defines the official time for the U.S.

Special Programs Office



RESEARCH, STANDARDS, FOUNDATIONS

Research in 8 focus areas:

- 1. DNA (forensic genetics)
- 2. Digital Investigations
- 3. Drugs & Toxins
- 4. Firearms & Toolmarks
- 5. Trace Evidence
- 6. Statistics

NIST Center of Excellence

Iowa State • CMU • UC Irvine •

UVA • Duke • WVU

- 7. Biometrics
- 8. Quality Assurance

Standards efforts involve administering **OSAC**

Foundation Studies

Our goal as the U.S. National Metrology Institute = quality measurements

NIST and the Nobel Prize

https://www.nist.gov/nist-and-nobel



Bill Phillips

1997 Nobel Prize in Physics Laser Cooling

Physics (1997)



Eric Cornell

2001 Nobel Prize in Physics Bose-Einstein Condensates

Physics (2001)



Jan Hall

2005 Nobel Prize in Physics Frequency Combs

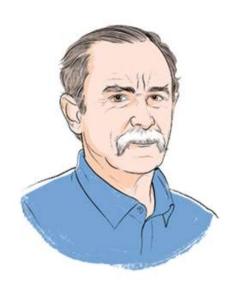
Physics (2005)



Dan Schectman

2011 Nobel Prize in Chemistry Quasicrystals

Chemistry (2011)



Dave Wineland

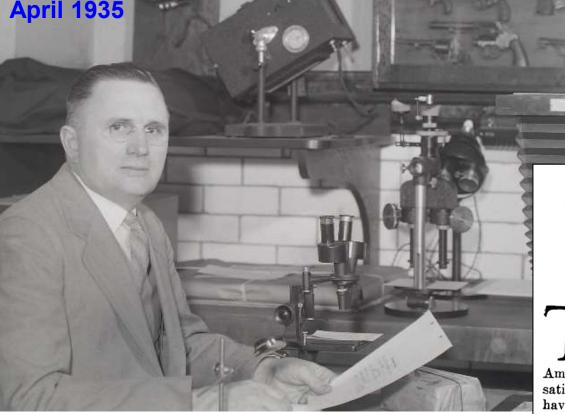
2012 Nobel Prize in Physics Experimental Quantum Mechanics

Physics (2012)

Wilmer Souder (1911-1913, 1917-1954), first forensic scientist at NIST, received his PhD in 1916 at the University of Chicago under two Nobel laureates Albert Michelson (Physics, 1907) and Robert Millikan (Physics, 1923)

Dr. Wilmer Souder

(first NIST forensic scientist, 1911-1954)



https://www.nist.gov/featured-stories/who-was-detective-x

See video: https://www.youtube.com/watch?v=a97A44ORnrE



When no one else can solve a mystery, Government heads put in a call for Dr. Souder

Washington's Detective X

Reader's Digest July 1951 pp. 118-120

Effective Testimony for Scientific Witnesses

Wilmer Souder*

3503 Morrison St., N.W., Washington, D.C.

Science (1954) 119: 819-822

HE research scientist is trained by instructors who are experts in his selected field of specialization. He reads professional magazines and converses with his colleagues. Among associates in his field, the writings and conversations are carried on from a vocabulary of words having very specialized meanings, content, and acceptance. Though quite unintelligible to the average listener, the conversations are highly meaningful to all associates. As a witness, he must present his findings in words and exhibits readily understandable by the audience.

The audience. When called to testify in a court of law, the scientist will find himself (professionally) among strangers, although all present may be citizens

the testimony, unless there are irreguarities in his career or in his reasonings in the special field. This is based on the judicial conception: "There must be no quarrels in the family." When the state's educational institution trains a citizen and presents him with a diploma guaranteeing certain attainments, rights and privileges, the state's judicial institution must not deny these credentials without well-documented reasons.

The expert. One definition of an expert is: "One who has acquired, by special study, practice, and experience, peculiar skill and knowledge in relation to some particular science, art, or trade." In admitting the expert, the judge usually explains to the jury that certain evidence is about to be introduced which is of

How Do You Measure Success?

NEW YORK TIMES BESTSELLER

HOW WILL

YOU MEASURE

YOUR LIFE?

CLAYTON M. CHRISTENSEN

JAMES ALLWORTH & KAREN DILLON



The Equation

Technology

People

Latest Instruments

Chemical Reagents

Laboratory Environment

Laboratory Management

Standard Operating Procedures

Culture of a Community

Training & Experience

Research Results

Casework Reports

Courtroom Testimony

A Rewarding Career

Component(s) + Process(es) = Outcome

How?

How well?

So what?

What?

Are We on the Right Side of the Equation?



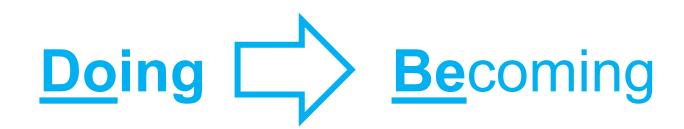
Left Side

Process-Driven Right Side

Performance-Based

Component(s) + Process(es) = Outcome

Systems Thinking is Looking at the Big Picture and How Inputs Impact Outputs...



DID JAMES PARSONS KILL HIS WIFE?

A Recent Article in *The Atlantic*

A bloodstain expert's testimony helped put him in prison. But can forensic science be trusted?

cites forensic focus on the left side of the equation

By Barbara Bradley Hagerty Illustrations by Isabel Seliger

"When asked to explain why forensics goes wrong, critics cite three factors.

First, some commonly used forensic methods have not been rigorously evaluated; ... Second, the overwhelming majority of crime labs are not independent ... Third, no one from the outside is rigorously checking the work done by forensic analysts, ..., accreditation largely focuses on having the right procedures spelled out on paper; proficiency tests given to lab analysts are extremely easy. ... The quality of the work done in crime labs is almost never audited."

The Dirty Dozen

Most Common Preconditions for Human Error









Lack of Knowledge



Distraction



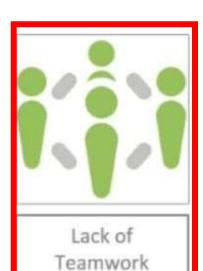
Stress



Lack of Resources



Pressure







Accepting the Norms



Fatigue



Lack of Assertiveness



5 B's to Strengthen Forensic Science from the Right Side of the Equation

- Be versatile (widen awareness to more than one area)
- Be communicative (be clear in communicating with all stakeholders)
- Be transparent (be honest with what we know and don't know)
- Be reflective (review the past to learn from it)
- Be kind (be part of a community)

The beehive is an image of industry (hard work) and community collaboration





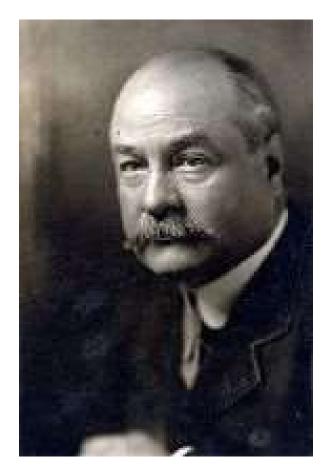
https://en.wikipedia.org/wiki/Beehive#/media/File:Western_honey_bee_on_a_honeycomb



Be versatile

widen awareness to more than one area

Definition of an Expert



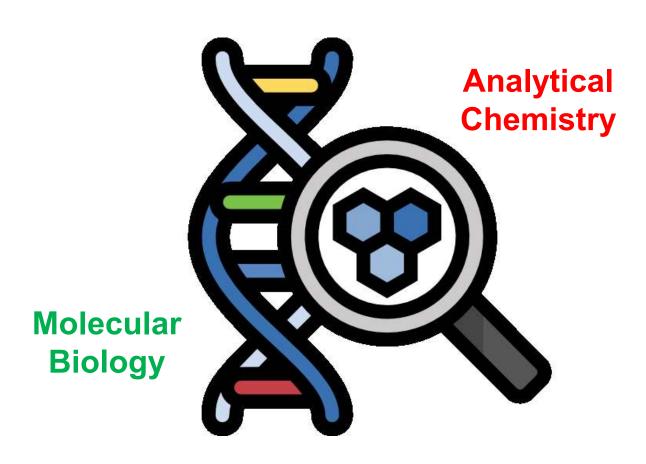
Nicholas Murray Butler (1862-1947)

"An expert is one who knows more and more about less and less until he knows absolutely everything about nothing."

"The one serious conviction that a man should have is that nothing is to be taken too seriously."

President of Columbia University from 1902 to 1945, President of the Carnegie Endowment for International Peace, and a recipient of the 1931 Nobel Peace Prize

My Early Scientific Career Benefited from Straddling Two Disciplines



My first two presentations were to very different audiences:

- Talk at Fourth Annual Frederick Conference on Capillary Electrophoresis (Frederick, MD), October 20, 1993, "Quantitation of PCR Amplified Mitochondrial DNA by Capillary Electrophoresis (CE)"
- 2. Talk at American Academy of Forensic Sciences (San Antonio, TX), February 19, 1994, "Quantitation of PCR Amplified Mitochondrial DNA by Capillary Electrophoresis (CE)"
- Being comfortable and operating in multiple domains has made me a more well-rounded scientist

My Career Shift in 2013

NIST Applied Genetics Group

Laboratory Based (focused efforts)

- Research Chemist and Group Leader
- Forensic DNA research 1995 to 1997 (postdoc), 1999 to 2013 (project & group leader)
- Authored five textbooks on forensic DNA

NIST Special Programs Office

Office Based (broad efforts)

- Special Assistant to the Director for Forensic Science
- National Commission on Forensic Science (NCFS), Vice-Chair 2013 to 2017
- Scientific Foundation Reviews 2017 to present
 - DNA mixture interpretation, digital investigation techniques, bitemark analysis, firearm examination
 - Multi-disciplinary teams who see the issues with different lens (e.g., statisticians, human factors)
- Assisting in other areas:
 - Helped set-up the Organization of Scientific Area Committee for Forensic Science (OSAC) 2013 to 2019
 - Serve on the Academy Standards Board (ASB) DNA Consensus Body 2015 to present
 - Supporting NIST research activities in all forensic disciplines



Participating in Multi-Disciplinary Meetings like EAFS Brings Benefits



 Learning from presentations outside of your area of expertise enables you to learn to think from the right-side of the equation



 When you become solution oriented with a broad perspective, you can take something you are learning in one area and apply it to another



social responsibility



 One of the goals of OSAC is to enable cross-disciplinary activities to strengthen more than one discipline in forensic science

NIST Conferences on Forensic Science

Assisting the community get to the right side of the equation since 2012



- Measurement Science and Standards in Forensic Firearms Analysis, July 10-11, 2012
- 2. Forensics@NIST 2012, November 28-30, 2012
- 3. ANSI/NIST-ITL Standard Workshop 2013, January 28-30, 2013
- 4. DNA Analyst Training on Mixture Interpretation, April 12, 2013
- 5. Emerging Trends in Synthetic Drugs Workshop, April 30-May1, 2013
- Measurement Science and Standards in Forensic Handwriting Analysis, June 4-5, 2013
- 7. Cloud Computing Forensic Science Workshop, March 24, 2014
- 8. NIST DNA Analyst Webinar Series: Probabilistic Genotyping and Software Programs (Part 1), May 28, 2014
- 9. NIST Mobile Forensics Workshop and Webcast, Jun 18, 2014
- 10. NIST DNA Analyst Webinar Series: Validation Concepts and Resources (Part I), Aug. 6, 2014
- 11. NIST DNA Analyst Webinar Series: Probabilistic Genotyping and Software Programs (Part 2), Sept. 18, 2014
- 12. Kickoff Meeting ANSI/NIST-ITL 1-2011 Update: 2015, Oct. 30-31, 2014
- 13. Forensics@NIST 2014, Dec. 3-4, 2014

- 14. Improving Biometric and Forensic Technology: The Future of Research Datasets, Jan. 26-27, 2015
- 15. <u>International Symposium on Forensic Science Error Management: Detection, Measurement and Mitigation</u>, July 20-24, 2015
- 16. Technical Colloquium: Quantifying the Weight of Forensic Evidence, May 5-6, 2016
- 17. <u>Trace Evidence Data Workshop: Improving Technology and Measurement in Forensic Science</u>, July 19-20, 2016
- 18. Forensics @ NIST 2016, Nov. 8-9, 2016 (Presentations; Posters)
- 19. <u>Technical Colloquium: Quantifying the Weight of Forensic Evidence</u>, June 27-29, 2017
- 20. International Forensic Science Error Management Symposium, July 24-27, 2017
- 21. Forensics @ NIST 2018, Nov. 7-8, 2018, in Gaithersburg, MD
- 22. <u>A Collaborative Exploration of Crime Lab Quality Infrastructure</u>, May 6, 2019, in Rockville, MD
- 23. Research Innovation to Implementation Symposium, June 19-20, 2019, in Gaithersburg, MD
- 24. Evidence Management Conference, October 2-4, 2019, in Gaithersburg, MD
- 25. Forensics @ NIST 2020, virtual conference Nov. 5 and 6, 2020.









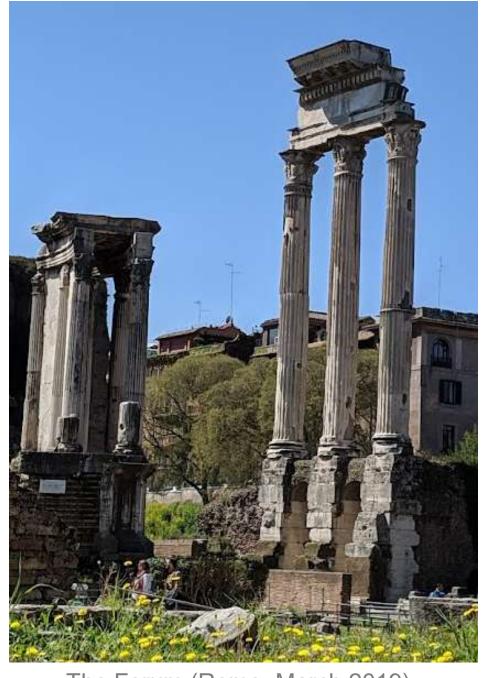
Be communicative

be clear in communicating with all stakeholders (internal and external)

A "Stakeholder"



https://www.istockphoto.com/photo/wooden-stake-in-a-hand-on-a-white-background-gm1026132644-275206141



The Forum (Rome, March 2019)

Forensic Scientists Should Be Good Communicators

- The word "forensic" originates from the Roman "forum" where public discussion occurred
- Complex topics need to be communicated clearly with stakeholders/customers (law enforcement and court officials) and members of the public
- Effective communication is needed in both written (with reports and research publications) and oral (courtroom testimony) forms

Workshop 039 (held here at EAFS on June 2) discussed Scientific Publication: Reading, Writing, and Reviewing

Writing for Practitioners and Researchers versus the General Public Is Very Different

2012

Advanced Topics in FORENSIC DNA TYPING: INTERPRETATION

Advanced Topics in FORENSIC DNA TYPING: METHODOLOGY

Fundamentals of Forensic DNA Typing

UNDERSTANDING FORENSIC DNA SUZANNE BELL & JOHN BUTLER

198 pages written in simple, clear language to help the general public understand forensic DNA

Cambridge University Press **2022**

David Spiegelhalter's Group on **Five Rules for Evidence Communication**

Consider what information - in what format - would best support your audiences' decisions.

Five rules for evidence communication

Nature (19 November 2020) Volume 587, pp. 362-364

Michael Blastland, Alexandra L. J. Freeman, Sander van der Linden, Theresa M. Marteau & David Spiegelhalter

Avoid unwarranted certainty, neat narratives and partisan presentation; strive to inform, not persuade.

e persuasive", "be engaging", "tell stories with your science". Most researchers have heard such exhortations many times, and for good reason. Such rhetorical devices often help to land the message, whether that message is designed to sell a product or win a grant. These are the traditional techniques of communications applied to science.

This approach often works, but it comes with danger.

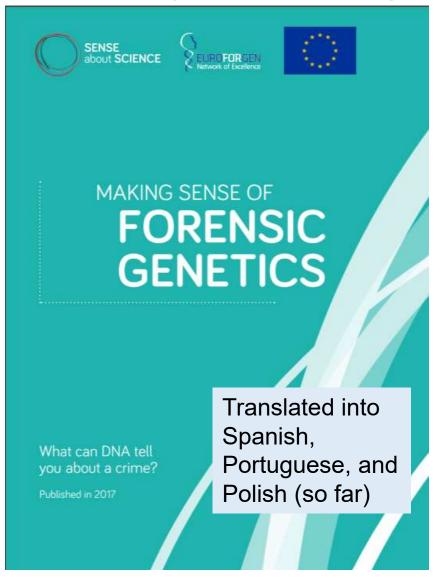
There are myriad examples from the current pandemic of which we might ask: have experts always been explicit in acknowledging unknowns? Complexity? Conflicts of interest? Inconvenient data? And, importantly, their own values? Rather than re-examine those cases, we offer ideas to encourage reflection, based on our own research.

Our small, interdisciplinary group at the University of Cambridge, UK, collects empirical data on issues such as how to communicate uncertainty, how audiences decide

- 1. Inform, not persuade
- 2. Offer balance, not false balance
- 3. Disclose uncertainties
- 4. State evidence quality
- 5. Inoculate against misinformation

Making Sense of Forensic Genetics (2017)

concepts clearly explained in 40 pages



- Developed by European Forensic Genetics Network of Excellence (EuroForGen-NoE) and published with Sense about Science
- Free PDF file available for download <u>https://senseaboutscience.org/wp-content/uploads/2017/01/making-sense-of-forensic-genetics.pdf</u>
- Final point made: "As DNA profiling continues to grow more sensitive, and it is used in more investigations, the need for accurate communication between scientists and nonscientists only grows - both to ensure that their expectations of the technology are realistic, and its limits are properly understood..."

"In this intriguing and beautifully crafted book, Innocence Project lawyer M. Chris Fabricant illustrates how wrongful convictions occur, and he makes it obvious how they could be prevented." — JOHN GRISHAM

JUNK SCIENCE

and the

AMERICAN CRIMINAL JUSTICE SYSTEM



M. CHRIS FABRICANT



Written with a compelling narrative and in a storytelling format to reach the general public

 Discusses bitemark analysis cases and problems with bitemark comparisons, hair microscopy, and fire investigations

The Audience Matters and Leads to Impact

Are we are the right side of the equation?

SCIENTIFIC AMERICAN.

https://www.scientificamerican.com/article/the-field-of-firearms-forensics-is-flawed/

ETHICS | OPINION

The Field of Firearms Forensics Is Flawed

The matching of bullets to guns is subjective, and courts are starting to question it because of testimony from scientific experts

By David L. Faigman, Nicholas Scurich, Thomas D, Albright on May 25, 2022

Reaching a wide audience of the general public with a compelling narrative





Forensic Science International: Synergy



journal homepage: www.sciencedirect.com/journal/forensic-science-international-synerg



Planning, design and logistics of a decision analysis study: The FBI/Ames study involving forensic firearms examiners

Keith L. Monson, Ph.D. a, Erich D. Smith, M.S. a, Stanley J. Bajic, Ph.D. b

- FBI Laboratory, Quantico, VA, 22135, USA
- K.L. Morgon et al. Foreruic Science International: Synergy 4 (2022) 100221

Table 1

| Author(s) | No. | Manufacturer | Seq. | Examiners | Design | Comparisons | | Error rate (FP/FN), percent | |
|-----------------------|------|----------------|--------|-----------|--------|--------------|---------|-----------------------------|-----------------------|
| | | | | | | Cartr. Cases | Bullets | Cartr. Cases | Bullets |
| Brundage, 1996 | 10 | Ruger | C | 30 | SB, C | | 1020 | | 0/0 |
| Bunch & Murphy, 2003 | 10 | Glock | C | 8 | DB, O | 360 | | 0/0 | |
| E. Smith, 2005 | 9 | Ruger | C R | 0 | SB, C | 360 | 360 | 0/0 | 0/0 |
| Fadul, 2011 | 10 | Glock | C | 103 | SB, C | | 2745 | | 0.4°/na |
| Fadul et al., 2013 | 10 | Ruger | C | 217 | SB, C | 3825 | | 0.06°/na | |
| Fadul et al., 2013 | 10 | Glock | C | 165 | SB, P | 1650 | | | 1.2º/na |
| Cazes & Goudeau, 2013 | 5 | HiPoint | C | 69 | SB, C | 852 | | 0/0 | |
| Baldwin et al., 2014 | 25 | Ruger | R | 218 | SB, O | 3270 | | 0.94 /0.37 | |
| Stroman, 2014 | 3 | Smith & Wesson | R | 25 | DB, C | 75 | | 0/0 | |
| Kerkhoff et al., 2015 | 10 | Various | R | 11 | DB, O | 341 | 55 | 0/0 | 0/0 |
| Hamby et al., 2016 | 1632 | Glock | R | 1 | NB, C | 13,30,896 | | O/na | |
| T. Smith et al., 2016 | 8 | Various | R | 31 | DB, O | 2046 | 2046 | 0.14/0.43 | 0/0.11 |
| Keisler et al., 2018 | 9 | Various | R | 126 | SB, C | 2520 | | 0/0 | |
| Kerkhoff et al., 2018 | 1 | Sig Sauer | R | 10 | DB, O | 344 | | 0/9 | |
| | 39 | Glock | я | | | | | | |
| Hamby et al., 2019 | 10 | Ruger | C | 697 | SB, C | 10,455 | | | 0.05 ¹ /na |

Royal SocietyPrimers for Courts

Forensic Science International 289 (2018) 287-288

Contents lists available at ScienceDirect

Forensic Science International

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



Commentary

Judicial primers—A unique collaboration between science and law



S. Black*, N. NicDaeid

Leverhulme Research Centre for Forensic Science, University of Dundee, Scotland, UK

https://royalsociety.org/about-us/programmes/science-and-law/



(2017, 60 pages)

(2017, 36 pages)

(2020, 72 pages)

(2021, 82 pages)

(2022, 32 pages)

(2022, 76 pages)

2-page Training Materials for Officers of the Court Under Development at NIST

Quality Assurance Framework Used in Forensic Science Primer: Accreditation and Certification



A Accreditation and Certification

Introduction

Conformity assessment plays a critical role in many sectors, including the forensic sciences, to demonstrate an adherence by an organization, individual, product, process, or system to specific requirements within that sector. Accreditation of organizations and certification of people are two types of conformity assessments.

Accreditation and Certification Overview

Although accreditation and certification, as types of conformity assessment, are granted following similar methodology, they differ in objectives and purposes. Accreditation is granted to an organization to recognize conformance with agreed-upon requirements, technical competence, and organizational effectiveness. Certification of people is granted to recognize an individual's competence of required knowledge, skills, or abilities. An impartial third party conducts a review and attests to the requirements being met when they grant accreditation or certification.

Both are important and complementary components of conformity assessment. It should be noted that the impartiality, consistency, and competence of the accreditation or certification body impact the quality of the conveyed conformity assessment information. Similarly, the types of assessment activities and the adequacy and appropriateness of the standards used to evaluate conformity also impacts the quality of the conveyed assessment information.

Quality Assurance Framework Used in Forensic Science Primer: Accreditation and Certification

The Conformity Assessment Method



Additional Considerations

| | Accreditation of Organizations | Certification of People |
|------------|--------------------------------------|----------------------------------|
| Strength | | |
| Challenges | Critics raise concerns that it is an | Critics raise concerns about the |

have been granted accreditation. International Accreditation Forum

Some Features:

Cross-cutting topics like accreditation

- Brief explanations
- Comparisons made
- Limitations discussed
- Examples provided
- Links to more information
- **Key Takeaways**

A Comparison of Accreditation and Certification

Accreditation of Organizations

- Testing and calibration laboratories Inspection bodies (IBs)
- Proficiency test providers (PTPs)
- Reference material producers (RMPs)
- Certification bodies (CBs)

Provided By

Available For

Accreditation bodies (ABs) – Several ABs exist in the forensic science sector, although one AB accredits most forensic science service providers (FSSP).

Process

- · The scope of work to be assessed is determined.
- Accreditation requirements are agreed upon (e.g., International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) standard, AB-specific
- · An audit of a sample of records, sufficient to determine conformance, is performed.
- One or more reports are issued with audit findings. All non-conformance findings require acceptable
- . The AB decides to grant or renew accreditation for the scope of work assessed.
- The AB makes the accreditation scope and certificate publicly available.

Surveillance

Assessment activities at a specified time frame (typically annually) ensure key elements of the requirements are still being met. This is less rigorous than the initial assessment or reassessment audits.

Additional Information Reassessment must be made prior to the end of the accreditation cycle that cannot exceed five years. The AB can extend, reduce, suspend, or withdraw accreditation.

National Institute of Standards and Technology Forensic Science Training Primer for Officers of the Court

Forensic Science Examples

The majority of United States (U.S.) FSSPs are accredited based on an ISO Standard (e.g., ISO/IEC 17025). Use this link to find U.S. ABs recognized for accrediting testing and calibration laboratories and inspection bodies. From the AB's website, you can search the FSSPs that they accredit and review their scope of accreditation.

International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA)

Information on who a CB has certified is not publicly available, but this directory can be searched to identify CBs that Multilateral Recognition Arrangement

Key Takeaways



- . The scope of accreditation to determine if it covers the work performed in a specific case.
- . The scope of a person's certification to determine if it is relevant for the specific case.



Quality

- · Neither accreditation nor certification are an attestation related to a specific result.
- . The quality of the result still needs to be reviewed.

Related Primers

Documentary Standards

Leam More

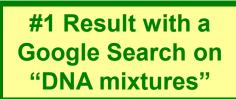
For additional information on conformity assessment (accreditation and certification), see:

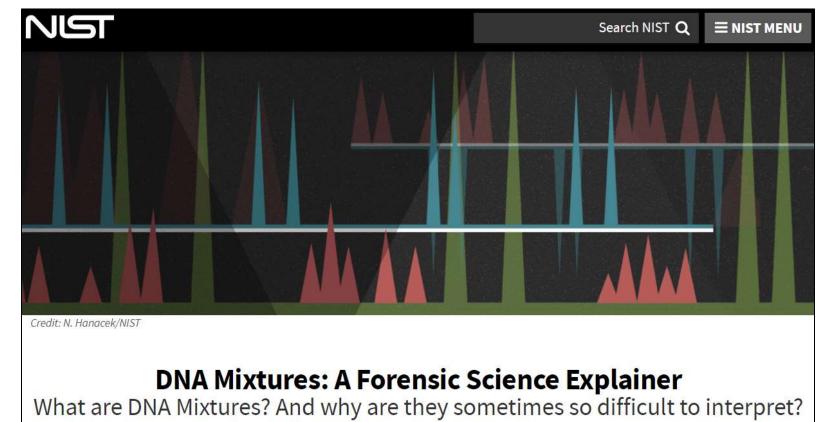
- ABCs of Conformity Assessment
- Why use an Accredited Laboratory (ILAC)
- NIST Standards Coordination Office, About Standards.gov

Glossary

A-2

NIST DNA Mixtures Explainer





By: Rich Press

April 03, 2019

Topics Covered

- Why have DNA mixtures and trace DNA become so prevalent?
- Are all DNA mixtures difficult to interpret?
- Why are complex DNA mixtures difficult to interpret?
- UNCERTAINTY #1: When is a peak a peak?
- UNCERTAINTY #2: Whose peak is it anyway?
- What is probabilistic genotyping software, and how does it help?
- How confident can one be that the DNA is related to the crime?
- Should labs just stop analyzing complex DNA mixtures altogether?



https://www.nist.gov/featured-stories/dna-mixtures-forensic-science-explainer

We Must Become Better at Communicating if we want to be on the right side of the equation



A Research Agenda

Committee on the Science of Science Communication: A Research Agenda

Division of Behavioral and Social Sciences and Education

A Report of

The National Academies of SCIENCES • ENGINEERING • MEDICINE

From this 2017 U.S. National Academies of Sciences Report:

- "Communicating science effectively ... is a complex task and an acquired skill." (p. 1)
- "Many believe the scientific community has a duty to engage with society to disseminate this knowledge and provide a return on society's investment in the science enterprise." (p. 11)
- "Any communication involves a communicator, an audience, and channels of communication that are often bidirectional..."
 (p. 11)
- "The scientific community has **an obligation to communicate** the results of its work to the rest of society." (p. 16)

Available at https://www.nap.edu/download/23674

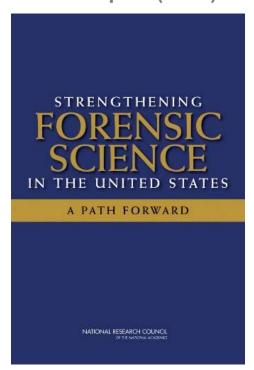


Be transparent

be honest with what we know and don't know

Requests for **Understanding What Data Exists**Supporting Forensic Science Methods and Practices

NRC Report (2009)



"demonstrating the validity of forensic methods"
(Recommendation #3)

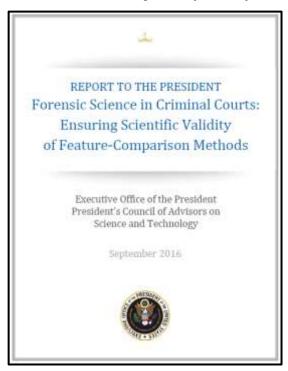
NCFS Recommendation (2016)



"technical merit evaluation"

Congressional funding uses NCFS language

PCAST Report (2016)



"establishing foundational validity"

NISTIR 8225 (2020)

NISTIR 8225

NIST Scientific Foundation Reviews

John M. Butler Melissa K. Taylor Sheila Willis* Special Programs Office

Associate Director of Laboratory Programs

Hari Iver

Statistical Engineering Division Information Technology Laboratory

Peter M. Vallone Biomolecular Measurement Division

Material Measurement Laboratory

Director's Office emational Associate under contract; retired director of Forensic Science Ireland

This publication is available free of charge from: https://doi.org/10.6028/NIST.IR.8225

December 202

Public Affairs



U.S. Department of Commerce Wilbur L. Ross, Jr., Secretary

National Institute of Standards and Technology Walter Copan, NIST Director and Undersecretary of Commerce for Standards and Technology

NIST: a "Scientific Foundation Review"

Trustworthy Results: A Shared Common Interest

- Obtaining <u>reliable (trustworthy, consistently accurate) results is</u> <u>an important goal</u> for forensic science, which NIST, as part of the forensic science ecosystem, shares in all our activities
- With NIST scientific foundation reviews, we are
 - 1. Documenting the **key scientific principles** that underpin current methods and practices
 - Cataloging <u>available literature and information</u> that describe the state of the field
 - Recommending strategies so that the community and its stakeholders <u>can</u> <u>have confidence in the results obtained</u> from a particular method or practice

NIST Scientific Foundation Reviews Underway in 2022

- 1. DNA Mixture Interpretation (initial pilot study)
 - Began in September 2017
 - AAFS 2019, ISHI 2019, ISHI 2020, AAFS 2021, AAFS 2022 workshops conducted
 - 250-page draft report released for public comment on June 9, 2021, with a 3-hour webinar held on July 21; compiled public comments released December 2021; plan to finalize later in 2022

2. Bitemark Analysis

- Began in October 2018
- Workshop held in October 2019

3. Digital Investigation Techniques

- Began in February 2019
- Interlaboratory "black box" study conducted from June to November 2020 → published Feb 2022
- 84-page draft report released for public comment on May 9, 2022, with a 2-hour webinar on June 1

Firearm Examination

- Began in October 2019
- Gathering literature and focusing on error rate studies

Draft out for public comment

Reports will be provided with each foundation study and made available for a public comment period (usually 60 days)

https://www.nist.gov/topics/forensic-science/interdisciplinary-topics/scientific-foundation-reviews

DRAFT Report: Digital Investigation Techniques

https://www.nist.gov/forensic-science/digital-investigation-techniques-scientific-foundation-review

NISTIR 8354-DRAFT

Digital Investigation Techniques: A NIST Scientific Foundation Review

James R. Lyle Barbara Guttman John M. Butler Kelly Sauerwein Christina Reed Corrine E. Lloyd

This publication is available free of charge from: https://doi.org/10.6028/NIST.IR.8354-draft

Document size (84 pages)

- 5 chapters
- 84 pages
- 12 Key Takeaways

 Public Comment being sought (May 9 to July 11, 2022)

We invite you to read and comment – are we on the right side of the equation with this draft?

NISTIR 8412

Barbara Guttman

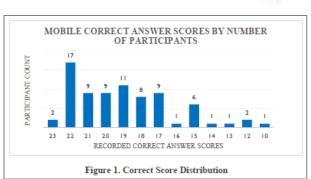
Results from a Black-Box Study for Digital Forensic Examiners

Mary T. Laamanen Craig Russell Software and System Division Information Technology Laboratory

Released **February 17, 2022**

††James Damell +National White Collar Crime Center †† United States Secret Service

This publication is available free of charge from: https://doi.org/10.6028/NIST.IR.8412



February 2022



U.S. Department of Commerce Gina M. Raimondo. Secretary

National Institute of Standards and Technology

James K. Olthoff, Performing the Non-Exclusive Functions and Duties of the Under Secretary of Commerce for Standards and Technology & Director, National Institute of Standards and Technology

Digital Forensic Interlaboratory Study

- This study was open to anyone in the public or private sectors who work in the field of digital forensics (U.S. or international)
- Evaluated accuracy of volunteer digital examiners with 24 questions using case scenarios and test artifacts for mobile devices and computer hard-drives
 - Tests were developed in collaboration with the U.S. Secret Service and the National White Collar Crime Center
- Study participants:
 - 77 mobile device and 102 hard-drive analyses
 - Demographic data collected related to an individual's workplace environment, education, and work experience

We estimate that more than 11,000 digital forensic units exist in the United States and internationally

Validation Studies: Are we considering the right side of the equation?

- A common claim is that a check-list of criteria have been met:
 - "validation of the [DNA test kit] was carried out in accordance with guidelines ...issued by the Scientific Working Group on DNA Analysis Methods (SWGDAM) and a series of tests ...were conducted." (FSIG 27:67-73)

Left side of the equation

Process-driven

Performance-based

Right side of the equation

SWGDAM Validation Guidelines for DNA Analysis Methods (2016)



4.1 Known and nonprobative evidence samples



4.2 Sensitivity and stochastic studies



4.3 Precision and accuracy: repeatability



4.3 Precision and accuracy: reproducibility



4.4 Mixture studies



4.5 Contamination assessment



4.4 Mixed DNA samples that are representative of those typically encountered by the testing laboratory should be evaluated

Studies assessing sensitivity and specificity under specific conditions representative of casework

Verification of performance through examination of how well the method works and what limitations exist

Media Coverage of the Issue

https://www.texastribune.org/2016/07/30/more-questions-austin-police-department-lab/

Austin Scrambles with Fallout of Closed DNA Lab

More than a month after the Austin Police Department was forced to abruptly shut down its DNA testing lab, it remains unclear whether any criminal convictions will be thrown out because of improper testing.

BY KHORRI ATKINSON JULY 30, 2016 12 AM CENTRAL

"In June, the Texas Forensic Science Commission told the department its audit had found that untrained staff and improper testing procedures raised concerns about the scientific validity of the lab's DNA test results."

"Lab analysts were using outdated methods to interpret test results and failed to correct and document contaminated DNA samples, the audit found."

Accreditation & Audits:

Are we considering the right side of the equation?

Austin (TX) Police Department (APD) DNA Laboratory Accreditation Timeline and Discussion March 2004--May 2016

Summary of Audits and Findings 2004-TFSC Audit

| ТҮРЕ | TOTAL#OF AUDITS/ ASSESSMENTS | ZERO FINDINGS | O NE FINDING | MORETHAN ONE FINDING | |
|-----------------------|------------------------------------|------------------|--|-------------------------|--|
| QAS | 5 | 3 | 1 | 1 | |
| ASCLD/LAB | 4 | 2 | 2 | | |
| Internal | 6 | 4 | 1 | 1 | |
| CODIS | 1 | 1 | | | |
| Serology Readiness | 1 | 1 | | | |
| TOTALS | 17 | 11 | 4 | 2 | |
| | | | Two-thirds of the APD audits had zero findings | | |

Slide courtesy of Lynn Garcia (presentation to the Texas Forensic Science Commission, August 18, 2017)

- Austin, Texas PD DNA Laboratory was shutdown in 2016 over concerns with DNA testing protocols
- They passed 17 audits over a 13 year time span
- In response to TX FSC concerns raised, a representative of the accrediting body stated "there is no consensus on what is acceptable in the DNA community" and "we [ANAB] do not establish the scientific foundation, but we assess to that. We expect the technical community to be establishing what scientifically needs to be done."

Texas Forensic Science Commission Meeting August 18, 2017 https://www.youtube.com/watch?v=-p_30-20kQl (at 4:03 of 5:45)

THE AUSTIN POLICE DEPARTMENT **DNA LABORATORY, 2010 – 2015:** LOOKING BACK TO MOVE FOWARD Report of the Quattrone Center for the Fair Administration of Justice University of Pennsylvania Carey Law School September, 2020



Austin (Texas) Police Department DNA Laboratory was closed in June 2016 due to problems with DNA mixture interpretation

158 page report released in September 2020

https://www.austintexas.gov/edims/pio/document.cfm?id=347884

- Identified 57 contributing factors and conditions that worked together to create an environment where errors occurred and persisted without appropriate oversight or correction
- Propose 87 recommendations for a new DNA laboratory to ensure independence, transparency, flexibility, and efficiency needed to serve the needs of the people of Austin



Be reflective

review the past to learn from it

Perspectives from History

In his 1933 talk to the International Association of Chiefs of Police entitled "Beware the Amateur Expert", Wilmer Souder from the National Bureau of Standards states:

• "Today many workers are operating without the least supervision or concern as to what is correct scientific procedure. Too often their enthusiasm outruns their training and ability. Some serious complications naturally develop under such conditions." He continues: "Success comes from skill in selecting the proper method and following it through in its correct application." And later: "The safe investigator has standards to be observed." He concludes: "I hope this bold admission of our lack of standards in what should be a highly scientific field will not discourage you."

In 1933 and 1934, Wilmer Souder spoke to the IACP. His remarks were reprinted in a 1977 book entitled "Silent Witness: The Emergence of Scientific Criminal Investigations", which is the third volume of a Police History Series.



A PATH FORWARD

Proposes establishing a **National Institute of Forensic Science**

73 years later... Perspectives from History

of the U.S. Civil Service Commission spoke to the International Chiefs of Police in 1936; his talk was entitled "Scientific Standards stigations":

a basis for evidence of instruments whose validity is not erely discredit investigation work."

greater knowledge of validity of [scientific] methods and the development of more valid measures."

 O'Rourke proposes setting up "a National Bureau of Standards in Criminology to conduct scientifically controlled experiments and to evaluate present practices." He emphasizes: "To make better use of [scientific] methods, law enforcement agencies must be certain of their limitations as well as of their merits."

His remarks were reprinted in a 1977 book entitled "Silent Witness: The Emergence of Scientific Criminal *Investigations*", which is the third volume of a Police History Series.



Ideals for Firearms Identification

Wilmer Souder, Army and Navy Journal, March 19, 1932

Are we learning from history or are we repeating it?

There should be adopted:

1. Minimum standards of equipment to be used.

OSAC efforts to prepare and share documentary standards (some efforts are being made here)

2. Standards for records of evidence to accompany and substantiate the expert's opinion; these to include photographs, metrological data and interpretations in permanent form.

Standards on Reports and Case Record Contents (some aspects covered in ISO/IEC 17025:2017)

3. Standards for qualification of experts which will include **actual tests** made against secretly designated materials and reported in compliance with item 2.

PCAST requests for empirical data to support all conclusions made (growing effort to address)

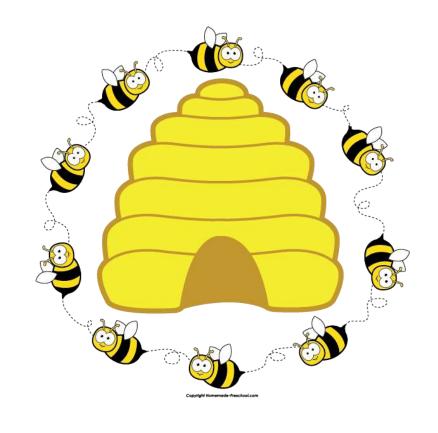
4. Methods for constant following up [with] experts testifying in court to guarantee the highest efficiency.

DOJ monitoring of FBI examiner testimony (to ensure compliance with ULTRs once adopted)

90 years later we are still addressing these same challenges!



Be kind



be part of a community

National Commission on Forensic Science (NCFS)

40 Commissioners

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

A Diverse Set of Perspectives:

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



February 3-4, 2014 was the first NCFS meeting

NCFS Closed with Charter Expiration

 The Attorney General's National Commission on Forensic Science's (NCFS) charter expired on April 23, 2017

• Completed two 2-year terms involving 13 meetings and approving 43 work products (20 recommendations to the Attorney General and 23 views of the

Commission)



https://www.justice.gov/archives/ncfs

National Commission on Forensic Science

> Reflecting Back— Looking Toward the Future

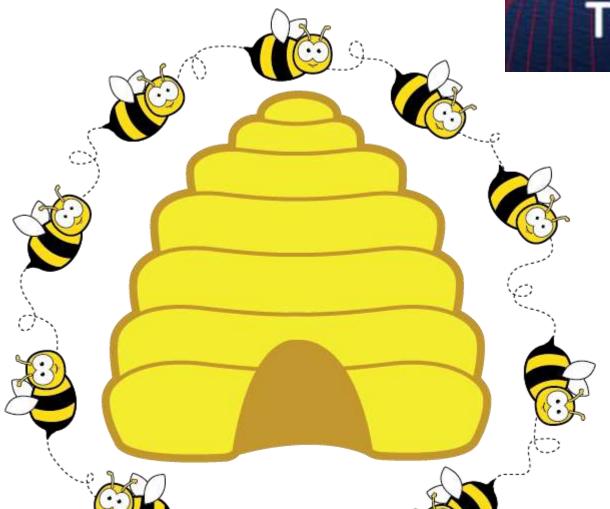
> > April 11, 2017

See summary document (58 pages) describing what was accomplished and thoughts on what needs still exist

https://www.justice.gov/archives/ncfs/page/file/959356/download

NIST maintains digital recordings of the NCFS meetings:

https://www.nist.gov/topics/forensic-science/national-commission-forensic-science



Together for a Safer World

- If you want to go fast, go alone
- If you want to go far, go together

- Attributed to an African proverb https://andrewwhitby.com/2020/12/25/if-you-want-to-go-fast/

Collaboration leads to being on the right side of the equation!



5 B's to Strengthen Forensic Science from the Right Side of the Equation

- Be versatile (widen awareness to more than one area)
- Be communicative (be clear in communicating with all stakeholders)
- Be transparent (be honest with what we know and don't know)
- Be reflective (review the past to learn from it)
- Be kind (be part of a community)

The beehive is an image of industry (hard work) and community collaboration





https://en.wikipedia.org/wiki/Beehive#/media/File:Western_honey_bee_on_a_honeycomb

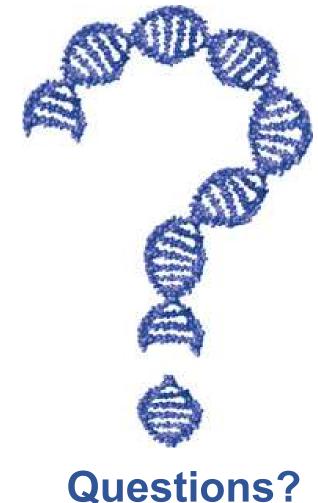
Thank you for your attention!

John Butler john.butler@nist.gov

https://www.nist.gov/topics/forensic-science



RESEARCH. STANDARDS. FOUNDATIONS.



Points of view are mine and do not necessarily represent the official position or policies of the National Institute of Standards and Technology. Certain commercial entities are identified in order to specify experimental procedures as completely as possible. In no case does such identification imply a recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that any of the entities identified are necessarily the best available for the purpose.