Genetisti Forensi Italiani
Virtual Presentation
12 November 2022

Scientific Research and Publication: The Value of Effective Communication to Advancing Quality Science

John M. Butler, PhD

National Institute of Standards and Technology, USA

Quote on p. xv, J.M. Butler (2015) *Advanced Topics in Forensic DNA Typing: Interpretation* (Elsevier: San Diego)

Doug Butler Thoughts on Learning

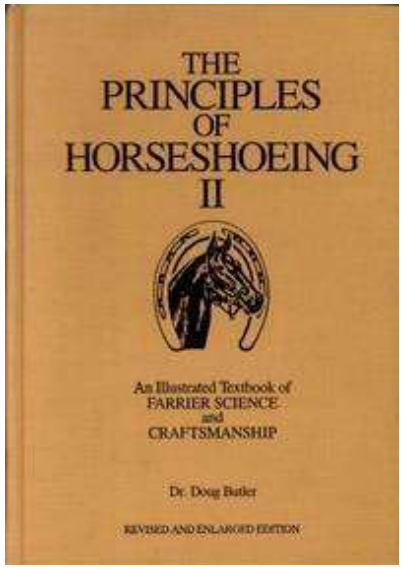
"You never really learn anything until you have to teach it to someone else."

Butler Professional Farrier School LLC
"The trusted voice in farrier education"

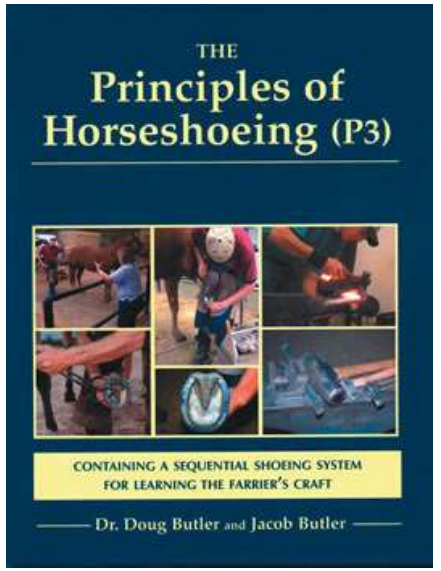
My father has written a dozen books covering his field of **horseshoeing** and started his own school after teaching at three different universities.

Making horseshoes

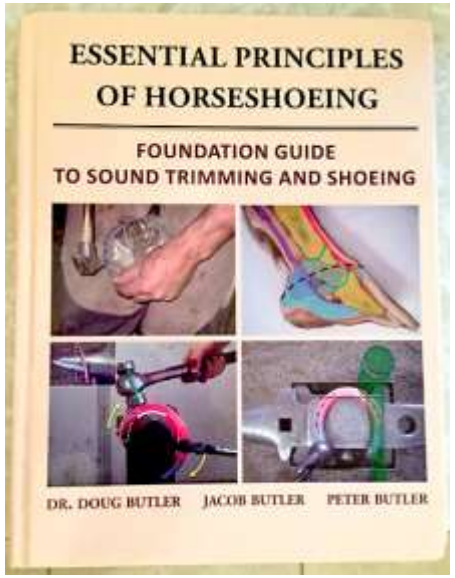
Putting shoes on the horse



1985



2004



His latest book (2012)

Family (six children)

A Little About Me

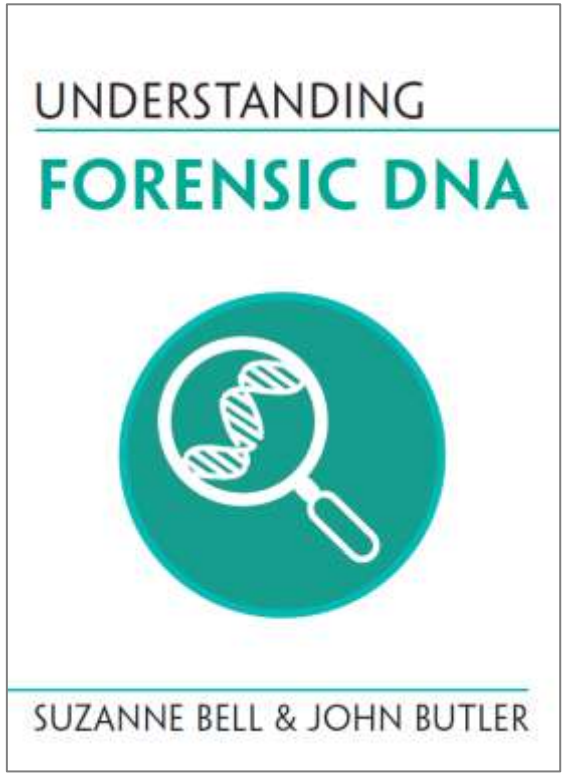
NIST National Institute of Standards and Technology U.S. Department of Commerce https://strbase.nist.gov/

Short Tandem Repeat DNA Internet DataBase

- I currently work in the Special Programs Office at the National Institute of Standards and Technology (NIST)
- I **perform research** in forensic science, **write articles** (>180 so far), **review articles** (>1,000 so far), and **teach others** about what I have learned (>500 talks in 26 countries so far)
- Researcher with the FBI (1993-1995), AFDIL (1995-1996), a start-up company (1997-1999), and NIST (1995-1997, 1999-2013, 2013-now)

2015
2012
2010
2005
2001

I have written five textbooks on DNA that are used all over the world



Cambridge University Press

2022

Writing the Books on Forensic DNA: Dr. John Butler
https://www.youtube.com/watch?v=e6yDJuV1TIs

Topics to Cover

1. Why conduct scientific research and share your results?
2. What are some lessons learned with scientific publishing?
3. What has been published recently in forensic genetics?
4. How to advance quality science with effective communication and good writing?

Why conduct scientific research and share your results?

Value of Scientific Publication

Gerard Piel
(1915 – 2004)
Publisher of *Scientific American* magazine

"Without publication, science is dead."

In a 1675 letter by Isaac Newton: **"If I have seen further, it is by standing on the shoulders of Giants."**

"A scientific experiment is not complete until the results have been published *and understood*." - Robert A. Day

Why Write and Why Review?

Forensic Science International: Genetics Supplement Series 4 (2013) e115–e116

Contents lists available at ScienceDirect

Forensic Science International: Genetics Supplement Series

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

The triad of scientific publication: Reading, writing, and reviewing

John M. Butler *

National Institute of Standards and Technology, Gaithersburg, MD, USA

https://www.fsigeneticssup.com/article/S1875-1768(13)00060-7/fulltext

…"An important purpose of scientific publication is to document work performed to aid the advancement of science. In short, writing enables history."

…"Reviewing manuscripts is a chance to influence the community for good and to provide service back to journals…"

Why Publish Scientific Articles?

- **To spread information and share new knowledge with others**
- To gain recognition, success and prestige for the authors and their institutions
- To win promotion to higher positions, job security, and tenure within academia
- To enhance chances of obtaining grants and research funding
- To gain priority for making a discovery

From Prof. Wayne Jones presentation at 19th IAFS meeting (Madeira, Portugal), 15 Sept 2011
"Publishing in Forensic Sciences: Where and How to Publish and the Meaning of Numbers"

Different Types of Articles

- **Original research articles**
- **Review articles**
- Short communications (termed “technical notes” in *JFS*)
- Book reviews
- Case studies (termed “case reports” in *JFS*)
- Opinion or commentary
- Letters to the Editor
  - typically correcting or commenting on a previous publication
- With *FSI Genetics*: Forensic population genetics (original paper, short communication, or correspondence)

Different journals can have different categories and/or required structures for manuscript submission

https://www.elsevier.com/journals/forensic-science-international-genetics/1872-4973/guide-for-authors

Ranking of the Value and Relevance of Scientific Writing

Lesser value

Greater value

- Website blogs and opinion pieces
- Non-peer reviewed articles
  - Conference proceedings
  - Letters to the editor
  - Many review articles
- Peer-reviewed research articles – with data!
- **Highly cited scientific articles**
  - Shows support from other scientists over time
  - **Truly a measure of "scientific acceptance"**

Who is Your Audience?

When You Write a Scientific Paper

- Other scientists
  - Your colleagues (those in the same field – e.g., forensic genetics)
  - Scientists reading outside their discipline (e.g., molecular biologists)
  - Students who are just getting started in the field
  - Non-native English-speaking scientists

- In some cases, members of the general public such as journalists or lawyers

What are some lessons learned with scientific publishing?

Training in Scientific Writing is Needed

"To expect scientists to produce readable work without any training, and without any reward for success or retribution for failure, is like expecting us to play violins without teachers or to observe speed limits without policemen. Some may do it, but most won't or can't."

- **Martin W. Gregory** (1992) "The infectiousness of pompous prose", *Nature* 360: 11-12

Important Steps to Address When Writing a Scientific Article

- Select a journal based on desired audience
- Decide on the scope of information
  - How much data will be covered? Should the material be subdivided into more than one article?
- Decide on article category
  - Research article, technical report, case report, etc.
- Pay attention to the reference format

<u>As an editor, one of the first things I examine is the reference list…</u>
If the authors are not consistent with their reference format or sloppy with details (e.g., missing volume or page numbers), then I may have concern with the quality of the work because **DETAILS MATTER IN SCIENCE!**

Some Decisions to Be Made

- How to subdivide information into digestible sections?
- What information is needed in Materials and Methods to permit someone to follow and repeat your experiments?
- What should be covered in a figure or table?
- What should be supplemental material versus material in the paper itself?

Thoughts on How to Write a Scientific Paper

- **Outline the ideas first** with a purpose and plan
  - Decide on scope & audience and select target journal
- Write Materials and Methods section first
- Prepare all figures & tables
  - captions should be stand-alone
- Write Results and Discussion based on data shown in figures & tables
- Write Introduction to provide context to your work
- Prepare reference list according to journal format
- **Write abstract last and then finalize title**
  - Most critical pieces since they will be the most read!

Read the "Author Guidelines", which are available from most journals!

Journal of Forensic Sciences: https://onlinelibrary.wiley.com/page/journal/15564029/homepage/forauthors.html
Forensic Sci. Int. Genet.: https://www.elsevier.com/journals/forensic-science-international-genetics/1872-4973/guide-for-authors

My Experience with Writing

- **Focus**
  - **Environment** – I need **a quiet place** with no interruptions in order to get into the flow of writing
  - **Time** – I need **long blocks of time** (around 6 hours has been optimal for me, which typically means late at night)

- **Perspective**
  - **Think from the readers' perspective** (this will require learning to step outside of yourself and see what you have written with fresh eyes)
  - Work on **content flow and clarity** (this will require multiple re-writes to your manuscript)
  - **Know your audience** (you should select a journal from which you have read articles previously)

Some Helpful Resources

- Duke Graduate School Scientific Writing Resource (https://sites.duke.edu/scientificwriting/)
- Whitesides, G.M. (2004). Whitesides' group: writing a paper. *Advanced Materials, 16,* 1375-1377. See video https://gmwgroup.harvard.edu/news/george-whitesides-how-write-paper-communicate-your-research.
- **Day, R.A. (1998). *How to Write & Publish a Scientific Paper, 5th edition*. Oryx Press: Phoenix, Arizona. [8th edition was published in 2016]**
- Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558.
- Ecarnot, F., et al. (2015). Writing a scientific article: A step-by-step guide for beginners. *European Geriatric Medicine, 6,* 573-579.

Robert A. Day is Professor Emeritus of English at the University of Delaware

How to Write & Publish a Scientific Paper (5th edition)

Table of Contents

Some Lessons on Scientific Publication

- Regularly read the literature to be familiar with your field
- Begin writing through developing an outline of the topics you plan to cover
- Consider your audience
  - Who do you hope will read what you write?
  - What do you want them to learn from what you write?
- To provide good flow with each sentence, place old information first, and place new, emphasis-worthy information at the end of the sentence

What has been published recently in forensic genetics?

20th International Forensic Science Managers Symposium
INTERPOL Headquarters, Lyon, France
10 November 2022

Recent Advances in Forensic Biology and Forensic DNA Typing 2019-2022

John M. Butler, Ph.D.

NIST Fellow & Special Assistant to the Director for Forensic Science

National Institute of Standards and Technology,

United States of America

Overview of Papers Reviewed

20th International Forensic Science Managers Symposium

Years Examined	2019, 2020, 2021, 2022 (through October 2022)
Number of Papers	**636 +137 = 773**
Number of Journals	**96** (*FSI Genetics* = 240)
Topics Covered	15+

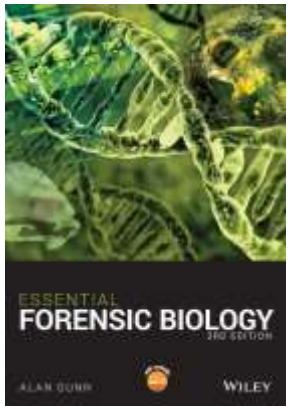
17th INTERPOL Review on DNA (2010-2013) examined **114 articles** (Jolicoeur 2013)
18th INTERPOL Review on DNA (2013-2016) examined **75 articles** (Laurent & Pene 2016)
19th INTERPOL Review on DNA (2016-2019) examined **235 articles** (Butler & Willis 2019)

Topics Covered: Forensic Biology and DNA Typing

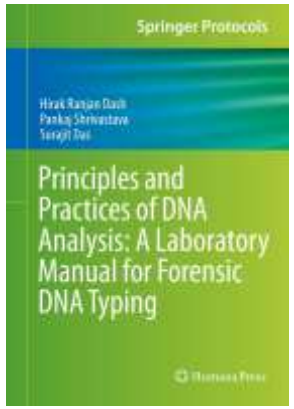
Hyperlinks to documents in tables and 50 footnotes to relevant websites

	# articles
1. Introduction	
1. Books, Special Issues, and Review Articles of Note	39
2. Guidance Documents (SWGDAM, OSAC, ASB, NIFS, ENFSI, UK Forensic Science Regulator)	70
2. Advancements in Current Practices ***(Practitioner Focused)***	
1. Rapid DNA Analysis	23
2. Use of DNA Databases (Familial Searching, Investigative Genetic Genealogy, Privacy and Ethical Issues, SAKs)	83
3. Forensic Biology and Body Fluid Identification	32
4. DNA Collection and Extraction	34
5. DNA Typing	35
6. DNA Interpretation at the Source or Sub-Source Level (Probabilistic Genotyping Software)	50
7. DNA Interpretation at the Activity Level (DNA Transfer)	45
3. Emerging Technologies, Research Studies, and Other Topics ***(Researcher Focused)***	
1. Next-Generation Sequencing	82
2. DNA Phenotyping (Ancestry, Appearance, Age Predictions) **+ Supplemental File (N=30+51+56)**	27 **+137**
3. Lineage Markers (Y-chromosome, mtDNA, X-chromosome)	67
4. New Markers and Approaches (Microhaplotypes, InDels, Proteomics, Human Microbiome)	69
5. Kinship Analysis, Human Identification, and Disaster Victim Identification	30
6. Non-Human DNA Testing and Wildlife Forensics	26

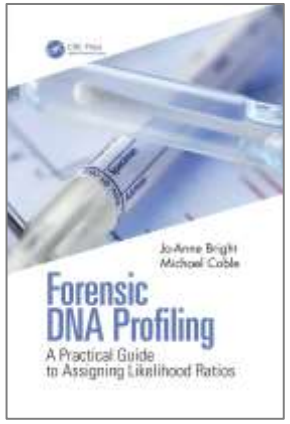
Recent Books on Forensic Biology and Forensic DNA Typing (2019-2022)



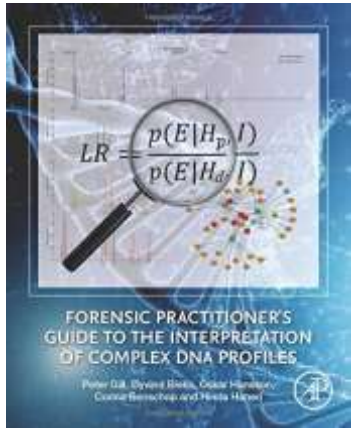
Essential Forensic Biology, Third Edition (2019, Wiley)



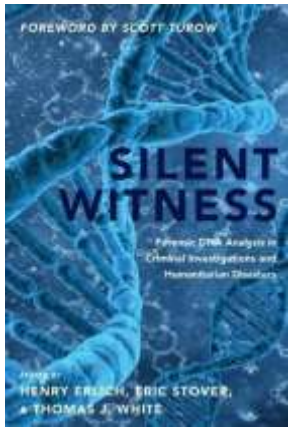
Principles and Practices of DNA Analysis: A Laboratory Manual for Forensic DNA Typing (2020, Humana Press)



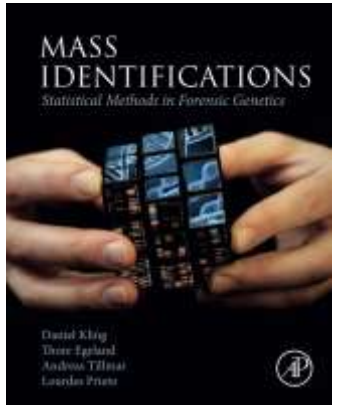
Forensic DNA Profiling: A Practical Guide to Assigning Likelihood Ratios (2020, CRC Press)



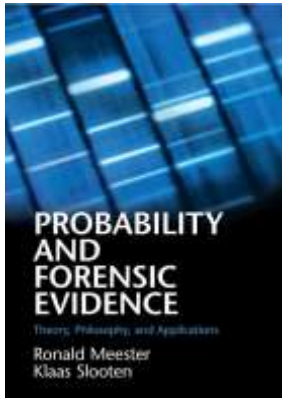
Forensic Practitioner's Guide to the Interpretation of Complex DNA Profiles (2020, Elsevier)



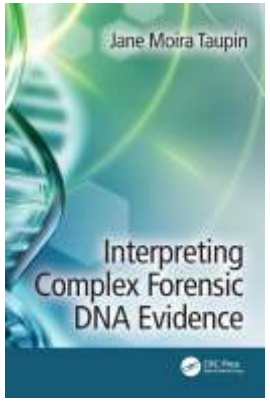
Silent Witness: Forensic DNA Evidence in Criminal Investigations and Humanitarian Disasters (2020, Oxford University Press)



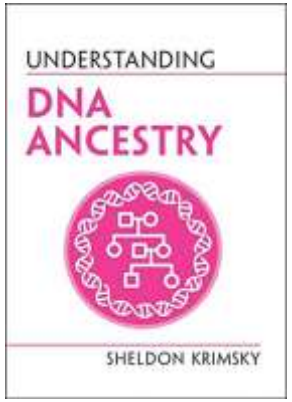
Mass Identifications: Statistical Methods in Forensic Genetics (2021, Elsevier)



Probability and Forensic Evidence: Theory, Philosophy, and Applications (2021, Cambridge University Press)



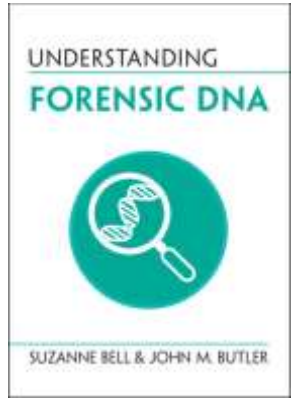
Interpreting Complex Forensic DNA Evidence (2021, CRC Press)



Understanding DNA Ancestry (2022, Cambridge University Press)

Handbook of DNA Profiling, 2 Volumes (2022, Springer)

1206 pages with 54 chapters from 115 contributors representing 17 countries



Understanding Forensic DNA (2022, Cambridge University Press)

Investigative Genetic Genealogy Review Article

Forensic Science International: Genetics 52 (2021) 102474

Contents lists available at ScienceDirect

Forensic Science International: Genetics

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

Review article

Investigative genetic genealogy: Current methods, knowledge and practice

Daniel Kling [a,b,*], Christopher Phillips [c,**], Debbie Kennett [d], Andreas Tillmar [a,e]

[a] Department of Forensic Genetics and Forensic Toxicology, National Board of Forensic Medicine, Linköping, Sweden
[b] Department of Forensic Sciences, Oslo University Hospital, Oslo, Norway
[c] Forensic Genetics Unit, Institute of Forensic Sciences, University of Santiago de Compostela, Santiago de Compostela, Spain
[d] Research Department of Genetics, Evolution and Environment, University College London, Gower Street, London WC1E 6BT, United Kingdom
[e] Department of Biomedical and Clinical Sciences, Faculty of Medicine and Health Sciences, Linköping University, Linköping, Sweden

ARTICLE INFO

Keywords:
Genetic genealogy
SNP microarrays
Whole-genome-sequencing
Familial searching
Identity by descent
Forensic DNA analysis
Crime investigation

ABSTRACT

Investigative genetic genealogy (IGG) has emerged as a new, rapidly growing field of forensic science. We describe the process whereby dense SNP data, commonly comprising more than half a million markers, are employed to infer distant relationships. By distant we refer to degrees of relatedness exceeding that of first cousins. We review how methods of relationship matching and SNP analysis on an enlarged scale are used in a forensic setting to identify a suspect in a criminal investigation or a missing person. There is currently a strong need in forensic genetics not only to understand the underlying models to infer relatedness but also to fully explore the DNA technologies and data used in IGG. This review brings together many of the topics and examines their effectiveness and operational limits, while suggesting future directions for their forensic validation. We further investigated the methods used by the major direct-to-consumer (DTC) genetic ancestry testing companies as well as submitting a questionnaire where providers of forensic genetic genealogy summarized their operation/services. Although most of the DTC market, and genetic genealogy in general, has undisclosed, proprietary algorithms we review the current knowledge where information has been discussed and published more openly.

Highlights

- Comprehensive review of investigative genetic genealogy from a forensic perspective
- Background outlined for the DNA methodology and long-range familial searching process
- Survey of current direct-to-consumer testing companies connected to investigative genetic genealogy
- Overview of DNA technologies focusing on high-density SNP genotyping

147 references cited with 7 supplemental files

Summary of Recent Advances

- **Aiding** Investigations
  - Phenotyping and Ancestry Testing (VISAGE and beyond)
  - Investigative Genetic Genealogy (GEDmatch and growing commercial support)
- **Improving** Methods
  - DNA recovery, extraction, quantitation, amplification chemistry, new kits
  - Process mapping, standards and guidance documents
- **Speeding and Strengthening** Analysis
  - Rapid DNA
  - Massively Parallel Sequencing
- **Innovating** Interpretation
  - Probabilistic genotyping software for DNA mixtures
  - Activity level evaluations using DNA transfer studies

*These advances are **reported in the scientific literature and summarized in this INTERPOL review** so that we can, as Isaac Newton famously stated, "stand on the shoulders of giants" to see further*

How to advance quality science with effective communication and good writing?

Benefits of Reading the Literature

- You become familiar with authors and institutions
- **You can improve as a writer and a presenter**
- Your laboratory can improve its protocols
- **Over time you will be building your knowledge**
  - In graduate school, I read over 100 articles on PCR before I ever did a single experiment
  - I have gathered and cataloged ~10,000 articles over the last 25 years of work in the forensic DNA field
  - My books include reference lists that are as comprehensive as possible (because of this reference collection)
- Remember: **You don't have to master every paper…**

How many scientific articles have you read recently?

Think of a paper that you enjoyed reading

What are the qualities that made it worth reading?

- Interesting title
- Concise and to the point
- New information
- Case work information
- Easy to understand
- New solutions to problems
- Short statements
- Short articles with good findings
- If you want to reproduce a method, then you appreciate the detail
- Articles that inspire you (new fields that are discovered)

Some Responses from Participants in my 2019 Workshop

Why Read the Literature?

- Reading the relevant literature is crucial to developing expertise in a scientific field

- You must keep reading to be familiar with advances that are regularly being made

- **Your writing improves the more you read**
  - Being widely read in your field helps you prepare **relevant reference** lists and **insightful introductions** to your submitted manuscripts *or in your internal validation summaries*

- **Your ability to review other's work will improve…**
  - Being widely read in your field helps you be better able to critique different papers and to design better experiments (e.g., you can go back to well-designed studies for examples)
  - ***Remember that just because something is published does not mean that it is necessarily the "best" work or completely relevant to what you may be doing***

How to Read a Scientific Article

John Butler's perspective and not a formal standard!

- Skim the article first
  - Start with title and abstract (may consider authors as well)
  - Scan tables, figures and figure captions

- Examine results and conclusions
  - Do the data presented support the statements made?
- Do not worry about trying to comprehend the entire article at first
  - Most articles will be skimmed rather than read from start to finish
  - **Many articles are never read in detail**
- **Highlight key points and make notes on the paper** itself so you can go back to them later to refresh your memory

Suggestions for Writing and Re-Writing

- Write, then read, then re-write, then read, then re-write (continue this process as needed)
  - **Dozens of drafts may be required to polishing a text into the desired document**

- **Read the text out loud as you are editing…**
  - Write as if you were presenting to a friend

- Write in short sentences where possible
  - Omit unnecessary words
  - Don’t use words your audience will likely not understand. Your goal is to clearly explain your work, not sound smart.

See Martin W. Gregory (1992) “The infectiousness of pompous prose”, *Nature* 360: 11-12

Additional Thoughts on Writing

- **Writing involves a lot of re-writing** (edit, edit, edit)

- Re-read your manuscript one final time before submission (perhaps after waiting a day or two to approach it with a fresh perspective)

- **Ask others for their input** (and be willing to listen and learn from their suggestions)
  - At NIST, we have an internal review process for all manuscripts before they are submitted to a journal

English Language Assistance

- If English is not your primary language, it may be helpful to obtain language editing help
- **Reviewers and editors may reject your article outright if it contains poor English**
  - This is a common challenge for many articles submitted from Asia
- On-line resources exist to improve your English writing skills (e.g., https://sites.duke.edu/scientificwriting/)
- Fees to perform English editing can be hundreds of dollars per manuscript

The Science of Scientific Writing

George Gopen & Judith Swan (1990)

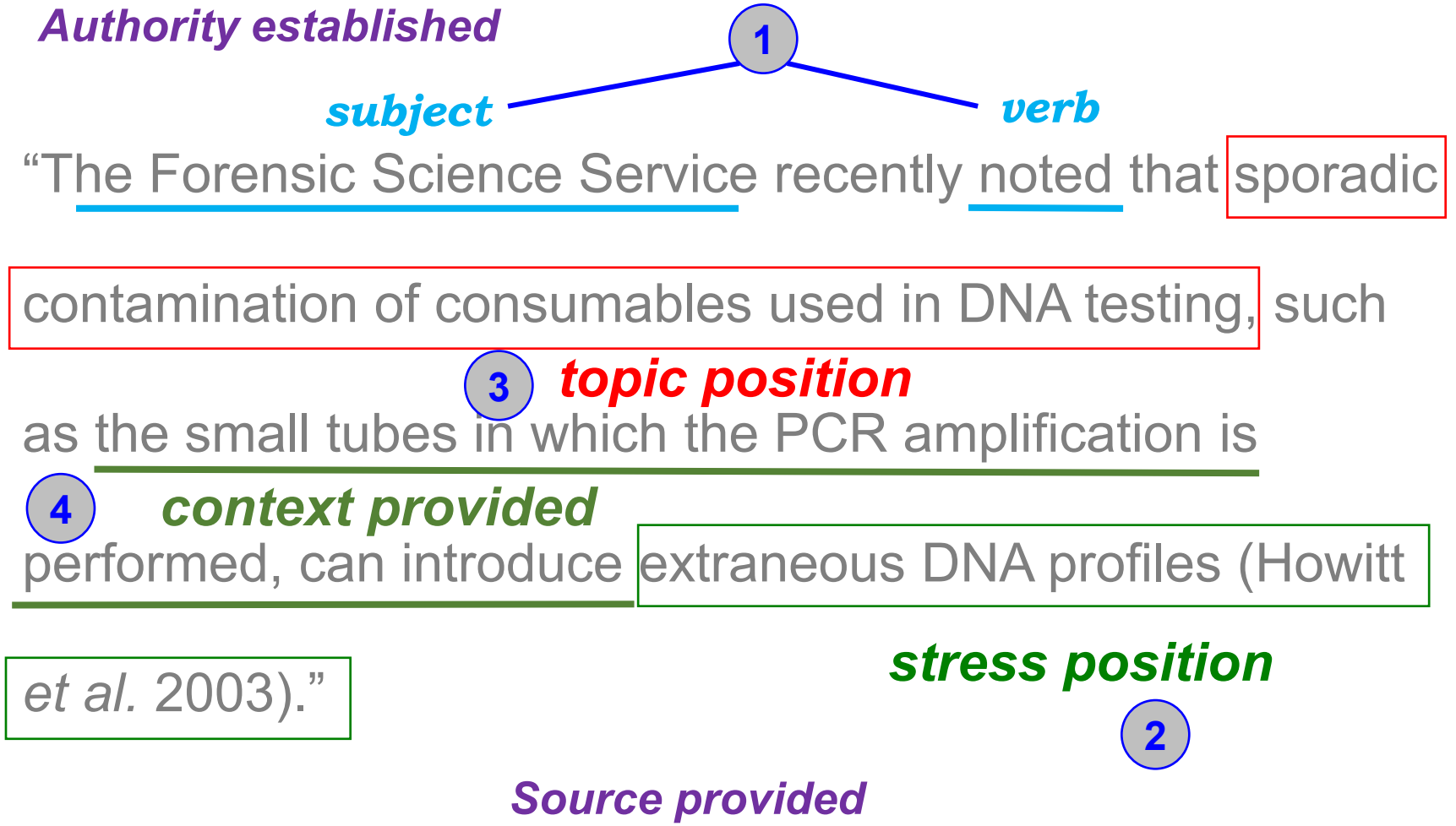
Some Recommendations to Improve Accessibility:

1) Put grammatical subjects close to their verbs
2) Put information intended to be emphasized towards the end of a sentence (the **stress position**)
3) Place the person or thing whose "story" a sentence is telling at the beginning of the sentence (the **topic position**)
4) Provide context for the reader before sharing anything new

To provide good flow, place old information in topic positions, and place new, emphasis-worthy information in stress positions.

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558

An Example of These Gopen & Swan (1990) Recommendations



Passage from J.M. Butler (2005) *Forensic DNA Typing, 2nd edition*, p. 153

How Data Are Presented Makes a Difference

(A) t (time) = 15', T (temperature) = 32°; t = 0', T = 25°;
t = 6', T = 29°; t = 3', T = 27°; t = 12', T = 32°; t = 9', T = 31°

(B)

Time (min)	**Temperature** (°C)
0	25
3	27
6	29
9	31
12	32
15	32

(C)

Temperature (°C)	**Time** (min)
25	0
27	3
29	6
31	9
32	12
32	15

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558

Why Readers Prefer a Specific Order

Contextual information appearing in regular steps

The "new" (measured) information

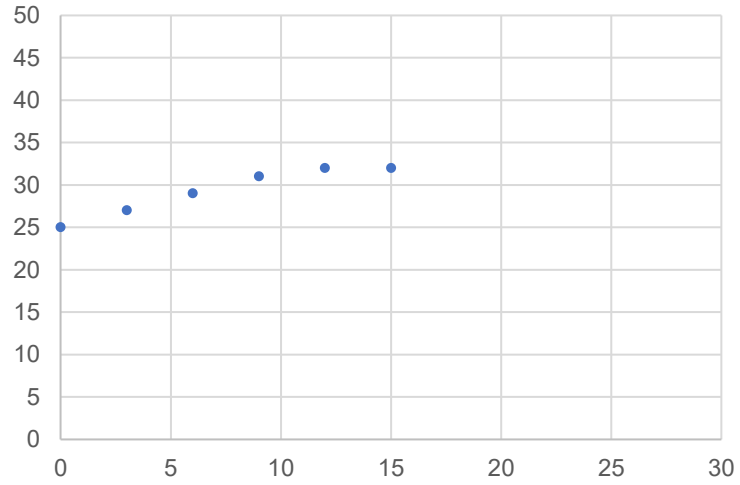
Time (min)	**Temperature** (°C)
0	25
3	27
6	29
9	31
12	32
15	32

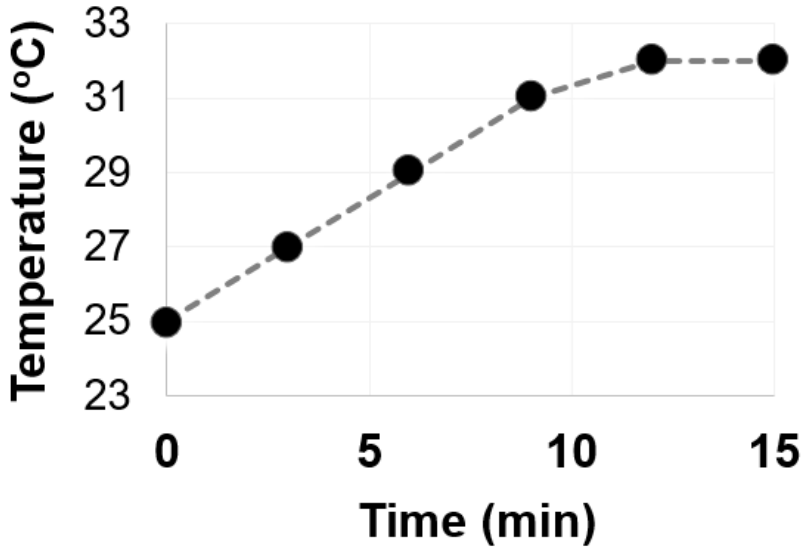
- In English, we read left to right
- Thus, we prefer **contextual information on the left** (in this example, time)
- And our brains prefer **the new information**, what we are trying to "discover" from the measurements made, **on the right** (in this example, temperature)

Gopen, G.D., & Swan, J.A. (1990). The science of scientific writing. *American Scientist, 78,* 550-558

The Same Data – but in a Figure Format

t (time) = 15', T (temperature) = 32°; t = 0', T = 25°;
t = 6', T = 29°; t = 3', T = 27°; t = 12', T = 32°; t = 9', T = 31°





No axis labels or units (min, °C)
Small axis values
Not scaled to emphasize data
Data points are small
Grid lines can be distracting

Table and Figure Captions

- Captions should be **descriptive enough** so that the table or figure **can be understandable independent of the text**

- I try to think through each element of the table or figure as if I was a reader encountering the information for the first time
  - Remember that writing involves telling a story about your findings so think carefully about how data are conveyed and described

My Overall Summary Thoughts

READ

- The best preparation to write well is to **critically read a lot of papers**

WRITE

- **Writing well takes practice** and is one of the most valuable skills you can develop
  - Effective communication benefits scientific advancement

REVIEW

- **Help review** the work of other scientists
  - Editors appreciate your willingness to be a reviewer when you are asked to help
  - Participating is an important way to give back to the community

Acknowledgments for Those Assisting Me in Gaining My Experience in Scientific Writing

Giving a copy of my 5th book on DNA to my professor, Ralph Allen, on his retirement (November 2015)

- **My father** inspired me to write through his example of authoring textbooks (my first book is dedicated to him)
- **My wife regularly corrects me and helps me ensure that my words can reach a non-scientist**
- Colleagues at NIST (particularly **Kathy Sharpless** & **Dave Duewer**) have provided input on my last three books & other research/review articles over the years
- Graduate school advisors (**Bruce McCord**, **Ralph Allen**, & **Bruce Budowle**) had an important influence on helping me writing my PhD dissertation and my first few research papers

Thank you for your attention!

John Butler

john.butler@nist.gov

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

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

MVPs of Forensic DNA

2021 (480): https://strbase.nist.gov/pub_pres/AAFS2021-W19-Handouts.pdf (pp. 3-35)

2022 (85): https://strbase.nist.gov/pub_pres/AAFS2022-W2-NIST-Forensic-DNA-Activities-FINAL.pdf (pp. 77-84)

Questions?

Forensics@NIST 2022 (happening this week)

https://www.nist.gov/agenda/forensicsnist-2022

(Free) Virtual Meeting
>1625 registrants from 70 countries
55 presentations + 5 workshops
Recordings to be available in two weeks

NIST Forensic Science Efforts

1. Conduct impactful **research**
2. Facilitate **standards** development
3. Assess **foundational** knowledge

DNA Mixture Interpretation
Digital Evidence
Bitemark Analysis
Firearm Examination

Research Focus Areas

Discipline-specific Focus Areas

- ITL Biometrics
- ITL Digital Evidence
- MML Drugs & Toxicology
- PML Firearms & Toolmarks
- MML Forensic Genetics
- MML Trace

Cross-discipline Focus Areas

- MML Quality Assurance
- ITL Statistics

Future Planning Priorities

- Computational Forensic Science
- Forensic Science Data
- Training Officers of the Court

csafe
Center for Statistics and Applications in Forensic Evidence

NIST Center of Excellence

Iowa State · West Virginia University