The Practice of Science 2021-2022 - Annotated Bibliography

This was substantially updated in light of experience this past Summer teaching a 10 week 'Practice of Science' course with undergrad researchers at the University of Washington. We read a set of articles on a topic and met for lunch each Monday for discussion.

I've focused below on things I've found useful, with a modest tilt toward print resources and some of the more obscure or older (but still useful!) resources to complement the burgeoning tide of web-accessible resources. Among these, the most useful is the 'Ten simple rules' collection at PLoS Computational Biology: https://collections.plos.org/collection/ten-simple-rules/

Consider the starred (*) articles as essential reading early in your career (or now, if they're new to you). Sample the remainder as time, interest and need–or need of diversion–dictate. **Enjoy, and send on your suggestions for including in our next update! We acknowledge all accepted additions!**

1. Getting Started - Choice of problem and direction

*Kahn, C.R. (1994) Picking a research problem: the critical decision. *New Eng. J. Med.* 330:1530-1533 (excellent advice in the form of 10 easily digested guidelines).

*Davis, M.M. (2000) How to ask questions (in 10 easy steps). *Current Biology* 10:R771. (a complement to Kahn, keyed to quotes from Bob Dylan songs among others).

*Platt, J.R. (1964) Strong inference. Science **146:**347-353. (required reading - exposition of the method of multiple working hypotheses and the role of disproof in the progress of science. For an interesting history of the origins of this method see: Pyne, S.T. (1978) Methodologies for geology: G.K. Gilbert and T.C. Chamberlain. *Isis* 69:413-424, at: http://www.jstor.org/stable/231044. My thanks to Martin McDonagh, University of Birmingham, Birmingham UK for pointing this reference out to me).

Alon, U. (2009) How to choose a good scientific problem. *Molec Cell* 35:726-728. The best of a short series Uri wrote on science in thought and practice.

Dyson, F.J. (2012) Is science driven mostly by ideas or by tools? *Science* 338:1426-1427. On the enduring tension between ideas and tools, and how both are needed to effectively drive science.

Wilson, E.O. (2013) *Letters to a Young Scientist.* Liveright Publishing/WW Norton, NY. 245pp. Like so much of what Wilson has written, accessible, inspiring and wise. A great contemporary complement to the following two books, that's available as a short YouTube talk on the same: https://www.youtube.com/watch?v=IzPcu0-ETTU&t=47s

Cajal, S. Ramón y (1999) *Advice for a Young Investigator*. MIT Press, Cambridge, MA. 150 pp. (reissue of Cajal's 1897 'career guide'includes such interesting chapters as 'Beginner's Traps' and 'Diseases of the Will'. Remarkably prescient! Cajal was a great Spanish neuroanatomist).

Medawar, P.B. (1979) *Advice to a Young Scientist*. Harper & Row, New York. 109pp. (see especially Chapter 3. A very useful and mature perspective from an exceptionally accomplished scientist-writer. Reissued in paperback).

2. Getting Stuff Done

*Yewdell, J.W. (2008) How to succeed in science: a concise guide for young biomedical scientists.

'Part I: taking the plunge' and 'Part II: making discoveries'. *Nature Reviews Molec Cell Biol.* 9:413-416 and 491-494. Jon's guide provides good advice, esp. Part II, again with a little humor.

*Fisher, D. (2003). The Henry Kunkel Legacy: through the eyes of his last graduate student. *Lupus* 12:172-174. (an engaging, informal look at Henry Kunkel and his essence as a mentor with a message: the creative spark for your science *must* come from you; smart people will *always* see an interesting angle on any solid result; and the way to build a big, interesting and potentially important story is that first small, solid experimental result. So get started!).

*Erren, TC, Cullen, P, Erren M, and Bourne, PE (2007) Ten simple rules for doing your best research, according to Hamming. PloS Comp Biol 3(10) e213. A painless introduction to Richard Hamming's advice, distilled from his now-iconic Bell Labs talk, which is much longer and discursive. Reprinted in Smith's collection noted below. See also Hamming's book *'The Art of Doing Science and Engineering: Learning to Learn'* Gordon and Beach, 1997. The last chapter of the discursive course Hamming offered at the Naval Postgraduate School is yet another version of Hamming's talk 'You and Your Research'.

Maxmen, A. (2009) Taking risks to transform science. *Cell* 139: 13-15, and Anne Sasso's 'Audacity' series in *Science Careers* (indexed at the following link: http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2009_11_06/caredit.a0900139. Big wins require luck, preparation and not a little courage! Lots of stories and inspiration here for scientists of all ages.

Hawkins, C. and Sorgi, M. (1985) *Research: How to Plan, Speak and Write About It*. Springer-Verlag, Berlin. 184pp. (little known short compendium - 8 useful chapters, research start to finish!).

Troidl H. et al. Editors (1998) *Surgical Research: Basic Principles and Clinical Practice*, 3rd Edition, Springer-Verlag, NY. 695pp. Another little-known but very useful series of short articles. Unusually broad compendium of advice and background on a wide range of more clinically- and surgically-oriented research topics rarely covered in more general guides. An unusual feature is the end-of-chapter commentaries by individual Editors that provide commentary and additional insight.

Bliss, E.C. (1976) *Getting Things Done.* Bantam Books, New York. (73 short chapters with a few amusing little drawings on how to tackle daily life. Got me to throw out all the other time management books I bought, but was procrastinating about reading!).

Allen, D. (2001) *Getting Things Done: The Art of Stress-free Productivity.* Penguin Books. (Useful advice on mastering workflow and managing projects from productivity guru David Allen. A short gloss is provided by James Fallows in the July/Aug 2004 *Atlantic Monthly*, entitled 'Organize your life!' pp.171-176. The gloss is simple – get it out of your head, organize it, chunk it and do it).

Hale-Evans, Ron (2006) *Mind Performance Hacks: Tips and Tools for Overclocking Your Brain.* O'Reilly. An engaging collection of short chapters with lots of interesting tips and tricks on things including memory, mental math, creativity, decision-making and 'mental fitness'.

3. Essential Skills I - Reading

Brenner, S. (1999) Remembrance of things past…reading. *Current Biology* 25:R115. Part of a series of short pieces by Sydney Brenner, always entertaining with useful nuggets on any topic.

Ratnoff, O.D. (1981) How to read a paper, Chapter 7 in Warren, K., ed. (1981) *Coping with the*

Biomedical Literature, Praeger, New York (very useful, if somewhat dated – I've taken his advice to contact authors with legitimate questions – they are often flattered and helpful!).

Erren, T.C., Cullen, P. and Erren, M. (2009) How to surf today's information tsunami: On the craft of effective reading. *Medical Hypotheses* 73:278-279. Very useful short article by the prime mover behind the 'Ten Simple Steps' series, published here in an out of the way place.

Carl Zimmer: 'How you should read coronavirus studies, or any science paper'. This short piece from June 2020 in the NY Times was written for general readers, but core advice well-taken: https://www.nytimes.com/article/how-to-read-a-science-study-coronavirus.html

Begley, CG (2013) Six red flags for suspect work. *Nature* 497:433-434. Short article on some guidelines for assessing the quality of published science and ensure reproducibility.

Medawar, P. (1963) Is the scientific paper a fraud? This was a BBC radio address by the redoubtable Medawar, gently reminding the audience of the gap between the mess that's day-to-day science and the finished product, the pristine, logical sequence we eventually publish to tell our stories. Republished in Medawar's collection of essays *'The Threat and the Glory - Reflections on Science and Scientists'* Harper-Collins.

Gladwell, M. (2002) The social life of paper. *New Yorker* 25 March issue. (The real skinny on paper, and why it's so useful: paper is a remarkably efficient and versatile, low cost, low tech but 'high-touch' crutch to support the life of the mind. This article starts with air traffic controllers, who use small scraps of paper to track and clear even very busy flight schedules. Available free at the author's website: www.gladwell.com).

Jabr, F. (2013) Why the brain prefers paper. *Scientific American* Nov 2013, pp.49-53. This is a great article to use to start arguments, especially across generational lines, and a good complement to Gladwell's article above. Less important than *how* you read is that you *do* read, and regularly. Twitter's going to carry you only so far in life...but this cultural invention power trio (language, written language and print on paper) has good prospects to carry us well into the 21st century…

Fawcett, P.J. (1978) Personal filing systems revisited. Ear Nose & Throat J. **57:**82-89 (an unlikely place for a small gem enunciating some timeless principles for organizing your life that carry well into the age of interweb-accessible information overload).

4. Essential Skills II – Writing (the first skill you need to get a lot better at…).

Mensh B, Kording K (2017) Ten simple rules for structuring papers. *PLoS Comput Biol* 13(9): e1005619. https://doi.org/10.1371/journal.pcbi.1005619 (another in the useful 10 Simple Rules series…).

Whitesides, G.M. (2004) Whitesides' Group: writing a paper. *Advanced Materials* 16: 1375-1377. George Whitesides got so fed up with lab members bringing him half-baked drafts of manuscripts that he wrote this short 'guide' for lab members emphasizing what manuscripts are and how to build them, *before* they came to him seeking advice!

Gardiner, M. and Kearns, H. (2011) Turbocharge your writing today. *Nature* 475:129-130. I love the authors' idea of 'snack writing'!

Bourne, P.E. (2005) Ten simple rules for getting published. *PLoS Computational Biology* 1(5):e57 (solid advice that's generally applicable across all fields).

Wells, W.A. (2004) Me write pretty one day: how to write a good scientific paper. *J. Cell Biol* 165:757-758.

Powell, K. (2010) Publish like a pro. *Nature* 467:873-875.

Albert, T. (2012) 'Tips on preparing your manuscript' BiomedCentral. Tim taught scientific writing for many years and distilled his wisdom in a great short 1 pager that, alas, is no longer available online. His website is still up and active however (see: https://www.timalbert.co.uk/writing-tips/) and I have a copy of the original 1 pager if interested – drop me a note…

Bredan, A.S. and van Roy, F. (2006) Writing readable prose. *EMBO Reports* 7:846-849. Useful advice in a readable short article.

Pruitt, B.A. Jr. and Mason, A.D., Jr. (1998) Getting your abstract on the program, Chapter 12 in Troidl H. et al *Surgical Research* mentioned above. Useful writing advice where there's little other published guidance.

Some style guides that may help…and a few on typography

Strunk, W. and White, E.B. (1999) *The Elements of Style*. MacMillan, New York. 85pp. (recently revised and updated writer's "bible" - buy it, read it, use it!).

Williams, J.M. (2005) *Style: Ten Lessons in Clarity and Grace.* 8th Edition. Pearson-Longman, New York. 274pp. (Very useful small book of advice that's directly and continuously applicable. Expensive, but worth it).

Thomas, F-N. and Turner, M. (1994) *Clear and Simple as the Truth: Writing Classic Prose.* Princeton University Press, Princeton, NJ. 225 pp. (one of the few recent books that addresses style as other than a 'technical' aspect of writing - includes a useful 'Museum' of examples and good bibliography).

Williams, R.(~1990 on) *The PC (or Mac) is not a Typewriter* series. Peachpit Press, Berkeley. (very useful older series providing a painless introduction to typography and how to use any word processor/graphics program to produce words/figures that look good and are a pleasure to read. Word processing programs paradoxically institutionalize lots of typographical mistakes and errors—e.g., this series will convince you never to 'fully justify' anything again! Use these to spot and correct the more egregious mistakes or achieve special effects. Little 'how-tos' that make the difference!

For more information on typography, the field once moribund until resurrected by digital fonts, see: "*Stop Stealing Sheep, and Learn How Type Works*" by Erik Spiekermann and E. M. Ginger. More detail can be found in Robert Bringhurst's classic "*The Elements of Typographic Style*" an in-depth, workbook-style look at typesetting. Read Carolina de Bartolo's "*Explorations in Typography*" (or just visit the book's terrific website). And Ellen Lupton's "Thinking With Type" (web link is: http://www.thinkingwithtype.com/) provides a good all-round introduction or self-teaching the basics. For all things typographic, see typographica.org

5. Essential Skills III – Speaking (the second skill where you need to up your game…).

McGovern, V. (2009) The one-minute talk. Let's start small, with the even shorter version of the elevator pitch—master this shortest of short forms first, which you'll use almost every day, then work up to the perfect short talk and hour lecture.

Emily Lakdawalla (2018) 'Speak your science!'. A great guide to speaking, by an animated solar system expert/planetary scientist who delivers great advice for whatever length talk you're slated to give. Her talk is in both written and video versions. *Choose one*…written: https://www.planetary.org/articles/0206-speak-your-science, or https://arizona.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=2d254148-7a7b-4a25-b76f-a87e014e1772 (you may need to paste entire link into your browser...)

Alon, U. (2009) How to give a good talk. *Molec Cell* 36:165-167. Solid advice from planning through execution.

Calnan, J. and Barabas, A. (1981) *Speaking at Medical Meetings,* 2nd Ed. Heinemann, London. 184pp. (a wide range of useful advice covering many different aspects of speaking. Great figures and cartoons are all illuminated with apt quotes from Shakespeare and ends with a pithy '10 Commandments' 1 pager…).

6. Essential Skills IV – Poster presentations

Erren, T.C. and Bourne, P.E. (2007) Ten simple rules for a good poster presentation. *PLoS Comp Biol.* 3:e102.

Maitreya's Stream of Consciousness Poster Presentation Guide (2014 - unpublished). A very useful guide to poster presentations created by my Genome Sciences colleague Maitreya Dunham - everyone should write her to encourage her to update and publish this!

Sam Hertig's detailed video guide to poster prep (2016). You can find this via the following link: go.nature.com/2aetlrc See also the related good article by Chris Woolston (2016) Lead the poster parade. *Nature* 536:115-117.

ABRCMS Judging Rubric - Poster and Oral Presentations (2019) ASM-ABRCMS. Very useful scoring sheet to help keep you on the straight-and-narrow when developing and presenting posters or short talks.

7. Essential Skills V – Graphics and imaging

Tufte, E.D. (1983/2001) *The Visual Display of Quantitative Information.* 1st/2nd Editions. Graphics Press, Cheshire, CT. 197pp. Let's start with the 'Bible'… the most useful and inspiring guide to graphical excellence in theory and practice. After reading this you'll never look at a multicolor, overproduced 3D Powerpoint slide again without weeping at the lost opportunity to accurately and economically convey *information*! See also Tufte's 3 sequels, the most recent of which, *Beautiful Information,* includes the full text of his take-no-prisoner's shred of Powerpoint. All 4 books are stunningly produced, equally useful and enjoyable to read or thumb through. Tufte also teaches a course that includes all of the books in the registration fee).

Rougier et al. (2014) Ten simple rules for better figures. *PLoS Comp Biol.* 10:e1003833. Don't get distracted by eye candy – message *always* trumps beauty.

Rolandi et al. (2011) A brief guide to designing effective figures for the scientific paper. *Advanced Materials* 23:4343-4346. Despite the somewhat stilted title, solid advice illustrated through successive revision of a starting figure. A similarly useful can be found in Kamat et al. (2014) Graphical excellence. *J Phys Chem Letters* 5:2118-2120.

UAB's Online Learning Tool for Research Integrity and Image Processing (2008 on). This can be found at: https://ori.hhs.gov/education/products/RIandImages/default.html and includes very useful guidelines for image processing best practices.

Buriak, J. (2011) Summarize Your Work in 100 Milliseconds or Less...The Importance of the Table of Contents Image. ACS Nano 5 (10): 7687-7689.

Buriak, J., ed. (2014) Titles and Table of Contents Images: The Candy Store Analogy. Chemistry of Materials 26 (3), 1289–1290. These two articles cover the latest high-stakes graphical image format, the Table of Contents image.

Wilke, C.O. (2019) Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures. O'Reilly. A sound guide with lots of examples and practical advice, particularly good on how to effectively capture different types of data, with illustrations.

Gustavii, Björn. (2008) How to Write and Illustrate a Scientific Paper, 2nd ed. New York: Cambridge University Press.

Hodges, Elaine R S., ed. (2003) The Guild Handbook of Scientific Illustration, 2nd ed. Hoboken, N.J.: John Wiley. ISBN: 978-0-471-36011-7. Serious industry standard stuff.

8. Essential Skills VI – Collaboration

Ledford, H. (2008) With all good intentions… *Nature* 452:682-684 and Hanawalt, P. C. (2006) Research collaborations: trial, trust and truth. *Cell* 126:823-825. (two accessible articles on research collaborations, one of the most important and potentially rewarding-or troublesome-aspect of modern science. Both articles include useful practical advice).

Kosik, KS (2020) A biologist talks to a physicist. Nature 577, 281-283 (2020), and Bohndiek, S. (2020) A physicist talks to a biologist. Nature 577, 283-284 (2020). This pair of articles provide both perspective, and practical advice for crossing disciplinary lines.

Brown, R.R., Deletic, A. and Wong, T.H.F. (2015) How to catalyze collaboration. *Nature* 525:315-317. Part of a multi-article insert on interdisciplinary science with several other interesting articles on how to work across disciplinary boundaries and with others.

Smalheiser, N.R. et al. (2005) Guidelines for negotiating scientific collaboration. *PLoS Biology* 3:e217. A short 2 pager with explicit checklist detailing different types of collaborative arrangements. A little stiff, but useful.

Frassl MA, Hamilton DP, Denfeld BA, de Eyto E, Hampton SE, Keller PS, et al. (2018) Ten simple rules for collaboratively writing a multi-authored paper. PLoS Comput Biol 14(11): e1006508.

Twyla Tharp and Jesse Kornbluth (2009) *The Collaborative Habit: Life Lessons for Working Together.* Interesting statement on the importance and mechanics of collaboration from one of the giants of 20th century American modern dance. This book aims to be a practical guide and is made all the more interesting by focusing on generalizable lessons.

9. Essential Skills VII - Statistical and Computational Tools

Haddock, S.H.D. and Dunn, C.W. (2011) *Practical Computing for Biologists.* Sinauer Associates, Sunderland, MA. Includes a plethora of topics in readily accessible form that are becoming increasingly important: familiarity with text manipulation and command line resources, programming (the appropriately focus on Python), computer graphics, remote access and building simple electronic devices using Arduino. A great way to dip your toe in on any of these topics.

Buffalo, V. (2015) *Bioinformatics Data Skills: Reproducible and Robust Research with Open Source Tools.* O'Reilly, 508 pp. This book picks up where Haddock and Dunn leave off.

R has become a standard scientific statistical computing package, esp. in light of the large and growing library of extensions. There are myriad good introductory books, free on-line tutorials and guides that will get you started.

Royle, S.J. (2020) *The Digital Cell: Cell Biology as a Data Science*. Cold Spring Harbor Laboratory Press. This short book is a delight – succinct readable chapters on project management, imaging, data processing, statistics and coding, with pithy 'Golden Rules' ending each chapter.

Goodman, A. et al. (2014) Ten simple rules for the care and feeding of scientific data. *PLoS Comp Biol* 10(4):e1003542. Echoes many of Buffalo's guidelines for data curation, transparency and reuse.

Hart EM, Barmby P, LeBauer D, Michonneau F, Mount S, Mulrooney P, et al. (2016) Ten Simple Rules for Digital Data Storage. PLoS Comput Biol 12(10): e1005097.

Wilson G, Bryan J, Cranston K, Kitzes J, Nederbragt L, Teal TK (2017) Good enough practices in scientific computing. *PLoS Comput Biol* 13(6): e1005510. *and*…

Noble WS (2009) A Quick Guide to Organizing Computational Biology Projects. *PLoS Comput Biol* 5(7): e1000424. (get started on the right foot with best practices. Wilson and colleagues and faculty colleague Bill Noble shows you how!).

Aly, M. (2018) The key to a happy lab life is in the manual. *Nature* 561, 7 (2018)
(Miriam Aly's lab wiki assembles a boatload of useful resources (https://osf.io/mdh87/wiki/home/). See especially the 'Coding, fMRI and Stats Help' listing with links.

Bailey, N.T.J. (1995) *Statistical Methods in Biology, 3rd Ed.* Cambridge University Press, Cambridge. 255pp. (Everyone needs a 'statistical crutch' - this is mine: good introductions to simple concepts and their application, with a Summary on what approach or test to choose as a function of distribution, sample size and type of comparison. Needs to be used with software (e.g., R), and a biostatistician you can trust and work with).

Swinscow, TDV (200) *Statistics at Square One.* 9th Ed. Revised by MJ Campbell. BMJ Press. (very

useful introductory text that first appeared as an articles series in the BMJ. Now available in print or on-line at the BMJ website: http://www.bmj.com/collections/statsbk/ - a great complement to Bailey).

Doerge, R.W. and Bremer, M. (2009) *Statistics at the Bench: A Step-by-Step Handbook for Biologists.* Cold Spring Harbor Laboratory Press. Another excellent addition to the CSH 'At the Bench' series, most recently re-issued with a focus on 'R at the Bench'.

10. Reproducibility and responsible conduct in science

King, D. (2007) The code. see: https://webarchive.nationalarchives.gov.uk/20070603172611/http://www.dti.gov.uk/science/science-and-society/public_engagement/code/page28030.html. The former UK government chief scientific advisor, Sir David enunciated seven short principles as a formal code of ethics for scientists. Tack these on the wall next to your desk or lab bench…

National Academies of Science (2009) *On Being a Scientist: A Guide to Responsible Conduct in Research*. Third Edition. Washington (DC): National Academies Press (US); 2009. PMID: 25009901. This NAS guide is solid, and available as a freebie.

Boeckhout, M. et al. (2018) The FAIR guiding principles for data stewardship: fair enough? Eur J Human Genetics 26:931-936. The principles for research data stewardship: findable, accessible, interoperative (common format, common standards) and reusable.

Goodman, A. et al. (2014) Ten simple rules for the care and feeding of scientific data. *PLoS Comp Biol.* 10:e1003542. Requoted from above, with the messages of 'Do it right, make it accessible, and support common standards and repositories'.

11. Moving on – your career from nappies (well, maybe grad school) through retirement…

Gu, J. and Bourne, P.E. (2007) Ten simple rules for graduate students. *PLoS Comp Biol* 3:2045-246. Stay focused, build confidence, skills and accomplishments, and keep an eye on the future.

Barres, B.A. (2013) How to pick a graduate advisor. *Neuron* 80:275-279 (also available as a shorter and snappier 2017 YouTube video: https://www.youtube.com/watch?v=THHkXpORUWo).
Ben Barres and Duncan Odum below give complementary perspectives on a critical career choice - where and who to work with. Barres is no longer with us, alas, but has an interesting backstory as a top-flight scientist who changed genders as a mid-career adult. See his just-published, posthumous 'Autobiography of a Transgender Scientist.'

Odum, D.T. (2013) How to evaluate a graduate studentship, or choosing the right doctoral advisor. *Genome Biology* 14:114.

Two interesting perspectives on the vexing issue of choice of a lab are given in: Holden, C. 'Eight attributes of highly successful postdocs', and Vogel, G. 'A day in the life of a topflight lab' (Bob Langer's lab at MIT), both in the 3 Sept 1999 issue of Science.

Lee, A., Dennis, C. and Campbell, P. (2007) *Nature's* guide for mentors. *Nature* 447:791-797. Even though this is billed as a guide ***for*** mentors, it has a great deal to say about identifying good or great mentors and the important roles a mentor plays in one's scientific career. Have a look!

series on-line: Science Magazine's 'Science Careers' site is excellent - many interesting articles and series covering a wide range of career advice and having an excellent collection of on-line resources. See above for a relatively recent example on the need for risk-taking in science. My first stop, as there's always something interesting here before diving into the web and science blogosphere.

series in-print: the 'Sticky Wicket' series in Journal of Cell Science is very entertaining, very funny and (usually!) anonymous, as was the previous, now apparently discontinued 'Caveman' series. What redeems this often-biting series is the skillful use of humor to address important topics in science and science or graduate training.

Huang K-l (2020) Ten Simple Rules for landing on the right job after your PhD or postdoc. PLoS Comput Biol 16(4): e1007723.

Tregoning JS, McDermott JE (2020) Ten Simple Rules to becoming a principal investigator. PLoS Comput Biol 16(2): e1007448.

Barker, Kathy (2002,2005) *At the Helm* and *At the Bench: Laboratory Navigator.* Cold Spring Harbor Laboratory Press. (two useful guides, one now in 2nd edition, by Kathy Barker of ISB on setting up and running your lab. *At the Helm* is the more useful of the two for senior students, post-docs and new faculty).

Langer, R. (2013) A personal account of translating discoveries in an academic lab. Nature Biotech. 31:487-489. How to go from idea to business or product in translational science. The recipe is: platform technology, a paper, a patent, proof-of-concept data and a champion for development.

Burroughs Wellcome/HHMI (2006) *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty. 2nd Edition* (a 250 pp guide that can be requested free from HHMI or downloaded and printed from the HHMI website where you'll find additional resources: http://www.hhmi.org/grants/office/graduate/labmanagement.html. Includes excerpts from the Barker books noted below as well. Very useful advice and free to boot!). Note: HHMI also funded a series of 'Future Faculty Fellows' boot camps at many institutions. These provide 2 days of very practical talks, hand-on advice and materials. If available to you, sign up both for the resources and opportunity to compare notes with other trainees and faculty.

American Society for Cell Biology (2004) *Career Advice for Life Scientists vols I-III.* These books are soft bound and free as pdfs (search the title or see the ASCB website) and a great complement to HHMI above.

Lara Szewczak with Amy Gladfelter and Tony Hyman (2018) Take a deep breath and switch. Cell 174:1333-1336. How do you change your science and direction mid-stream? This free-ranging moderated discussion between two accomplished scientists covers many aspects of how science can and should evolve over the course of one's career. The full version of the interview is available in the on-line version of this article.

Bourne PE (2018) Ten simple rules when considering retirement. PLoS Comput Biol 14(10): e1006411. https://doi.org/10.1371/journal.pcbi.1006411

Scudellari, M. (2015) A grand exit. Nature 521:20-23. Short Eurocentric look at different productive ways to wind down a career, featuring a few folks you may recognize by reputation.

Erren, T.C. et al. (2015) Ten simple rules for lifelong learning, according to Hamming. *PLoS Comp Biol* 11:e1004020. Hamming! Again! The most important guide to doing your best as a scientist that

you may never have heard of.

12. Style in Science/The Wellsprings of Creativity

Science Masterclass (2011 and subsequent editions). These Lindau Meeting short takes from a range of Nobel laureates on a very wide range of topics. Includes feedback from young scientists attending. *Nature* 478:S1-S20 (13 Oct 2011 issue). For more see the Lindau website: http://www.lindau-nobel.org/

See also the entertaining take in Peter Doherty's 'The Beginner's Guide to Winning the Nobel Prize', esp his Chapter 9 which is reprinted in Reginald Smith's compendium *Scientific Work and Creativity: Advice From the Masters* noted below.

Holton, G. (1978) Fermi's group and the recapture of Italy's place in physics, Chapter 5 in *The Scientific Imagination: Case Studies*. Cambridge University Press, Cambridge. 382pp. (Fermi was the last great physicist to be equally adept and accomplished as a theoretician and experimentalist. A good account of Fermi's work habits is given in Platt, J.R. (1962) *The Excitement of Science*, Houghton-Mifflin, Boston, Chs. 7 and 8).

Macfarlane, G. (1979) *Howard Florey: The Making of a Great Scientist*. Oxford University Press, Oxford. 396pp. (Fermi's biological counterpart - a great 20th century experimental pathologists, the developer of penicillin and the founder of the Dunn School of Pathology at Oxford).

Kanigel, R. (1986) *Apprentice to Genius: The Making of a Scientific Dynasty*. MacMillan, New York. 271pp. (the engaging and well-written story of the scientific dynasty that started with Steve Brodie is traced through Julius Axelrod, Sol Snyder and Candace Pert. Includes a good informal history of the NIH).

Smith, R., Editor (2012) *Scientific Work and Creativity: Advice From the Masters.* Citizen Scientist League, Clearwater, FL. Great compendium of 29 chapters including many excerpts from famous books and scientists. My thanks to the Editor, Reginald Smith, for bringing this to my attention.

Colapinto, J. (2009) Brain games. *New Yorker* 11 May 2009. A very interesting profile of behavioral neuroscientist Vilayanur Ramachandran, and how great science can be done with a combination of insight and modest resources.

Tharp, T. (2003) *The Creative Habit: Learn It and Use It for Life*. Simon and Schuster, 243pp. (very interesting statement on creativity and the conditions that foster creative thinking from one of the giants of 20th century American modern dance. This book aims to be a practical guide and is made all the more interesting by where it's coming from and by focusing on what promotes creativity across a wide range of disciplines).

13. The Larger World, and a few just for fun...

Note: this bibliography touches almost none of the current focus on issues of diversity, equity and inclusion. This ***does not*** reflect in any way upon the importance of these critical though still emerging community issues. Let me know what you've found the most useful resources on these important topics in science, and we'll generate a separate section for them next cycle…

Fiona Watt's series of interviews with prominent women in science ran in the *Journal of Cell Science* from 2003. Almost all address or illuminate issues women face and feel more often than men (sexism, exclusivity, demands of family and children), and often provide trenchant advice. She

wrote a summary of this experience and lessons learned in 2006: Watt, F.M. (2006) Women in cell biology: getting to the top. *Nature Reviews Mol Cell Biol.* 7:287-290.

Simone, J.V. (1999) Understanding academic medical centers: Simone's maxims. *Clin. Cancer Research* 5:2281-2285. Joe Simone is a senior academic physician who's held leadership roles at several cancer centers, most recently in Utah. After having heard his 'maxims' quoted so many times as wisdom of a sage, I was happy to find that they'd been captured for posterity, amusement and use. Topics include institutional realities, leadership, recruiting, job changing and success.

Peter Cook's Oxford website. Peter runs the Nuclear Structure and Function Research Group at the Dunn School of Pathology at the University of Oxford. His long-stranding interest in teaching and better-communicating is on display in his 'Resources' page that includes up-to-date material and live links to many very useful resources. See: http://users.path.ox.ac.uk/~pcook/w1/resources.htm

Medawar, P. (1982/1990) *Pluto's Republic* and *The Threat and the Glory,* Oxford U.P. and Harper Collins. (Medawar and Thomas (see below) were two of the most engaging and elegant stylists writing science in any century. Both are models of high intelligence, clarity and enthusiasm in presenting science and medicine to the public).

Thomas, L. (1974/79) *Lives of a Cell* and *The Medusa and the Snail.* Viking Press. (see note above. The first of these books was collected from a very unusual (for the time) column Thomas wrote for the *New England Journal of Medicine* entitled 'Notes of a Biology Watcher').

Sabertooth the lab head (2001) A memo to graduate students and post-docs. *J Cell Science* 114:2547-48. A tongue-in-cheek contribution to JCS's entertaining StickeyWicket/Caveman series reminding you—again—that you are the chief agent of your success or failure in science. The first sentence gives you the flavor: 'I'm sorry to be unhelpful, but I am **not** your mother!'

Frisch, O. (1979) *What Little I Remember*. Cambridge University Press, Cambridge. 227pp. (best title of any set of reminiscences, by a physicist who enjoyed enormously the science he was doing and the company it allowed him to keep. Great informal history of 20th century physics, illustrated with many photos and author's excellent sketches).

Feynman, R.P. (1985) *Surely You're Joking, Mr. Feynman!: Adventures of a Curious Character*. W.W. Norton, New York. 350pp. (Feynman's autobiography in the form of a collection of great stories he told his drumming buddy and fellow physicist Ralph Leighton. A gentle reminder that life and science are supposed to be fun).

Canfield, M.R. (2011) *Field Notes on Science and Nature*, Harvard U. Press. 320pp. A wonderful glimpse with lots of reproduced examples of field notes from a range of scientists using everything from a pencil and paper to electronic capture. Lots of luminaries here—do I wish I could draw like Jonathan Kingdon!

Dyson, F.J. (1988 on) *Infinite In All Directions.* Perennial/Harper & Row, New York. (these and subsequent lectures in *From Eros to Gaia* (1992)*, Imagined Worlds* (1997),and *The Sun, The Genome and The Internet* (1999) are great fun to read for Dyson's intellectual breadth and adventurousness, and his exemplary prose. All in paperback with his reissued autobiography. Alas, a giant no longer with us, except in spirit…).

Weatherall, D. (1995) *Science and The Quiet Art: The Role of Medical Research in Health Care.* Norton, New York. 378pp. (Excellent introduction to, history and defense of the role of basic research in medicine. Regrettably now out of print).

*A good history of whatever field you're working in. You need to know the context in which you're working. The best short introductions to the history of pathology include: Maulitz, R.C. (1993) The pathological tradition, chapter 9 pp.169-191 in Bynum, W.F. and Porter, R., eds. *Companion Encyclopedia of the History of Medicine*, Routledge, London; and Florey, H.W. (1958) The history and scope of pathology, chapter 1, pp.1-20 of *General Pathology*, 2nd edition, H. Florey, Editor, WB Saunders, Philadelphia. Both include additional suggestions for reading.

Hessenbruch, A., Editor (2000) *A Reader's Guide to the History of Science.* Fitzroy Dearborn Publishers, London. 934pp. (great compendium of short articles and annotated bibliographies on important areas and figures in the history of science).

Lazebnik, Y. (2002) Can a biologist fix a radio? - Or, what I learned while studying apoptosis. *Cancer Cell* 2:179-182. (amusing meditation on the coming tide of systems thinking as applied to biology. As is often the case, useful commentary and perspective again delivered with humor).

Langmuir, I. (1989) Pathological science. *Physics Today*, October 1989 issue pp.36-48. (transcript of a famous talk given by Nobel Laureate Langmuir at GE in 1953 on pseudoscience and self-delusional thinking. This formerly lost classic was unearthed, transcribed and edited by Robert Hall in 1966). ***see also:*** Rousseau, D.L. (1992) Case studies in pathological science. *Amer. Scientist* 80:54-63. (This includes the story of the disproof of 'polywater' by use of a sweaty post-handball T-shirt as lab material - this was included as part of what is still probably one of the best 'Methods' notes ever published by Science).

Sagan, C. (1997) *The Demon-Haunted World: Science as a Candle in the Dark*. Ballantine Books; Reprint edition. Carl Sagan's spirited defense of science and the importance of rational thought. No one should be let out of high school without reading his Chapter 12: 'The fine art of baloney detection', less politely called by Maria Popova 'Carl Sagan's Rules for Bullshit-Busting and Critical Thinking'.
In the same vein is the recently published '*Why People Believe Weird Things'* by Michael Shermer (WH Freeman, 1997 and recently updated). Shermer has also written the 'Skeptic' column for *Scientific American*. Look around - you'll have no trouble finding local examples...of people believing weird and worse!

Littlefield, J.W. (1984) On the difficulty of combining basic research and patient care. *Am. J. Hum. Genet.* **36:**731-735. Littlefield's useful advice on the vexing issue of how best to combine work on clinical and basic aspects of disease.