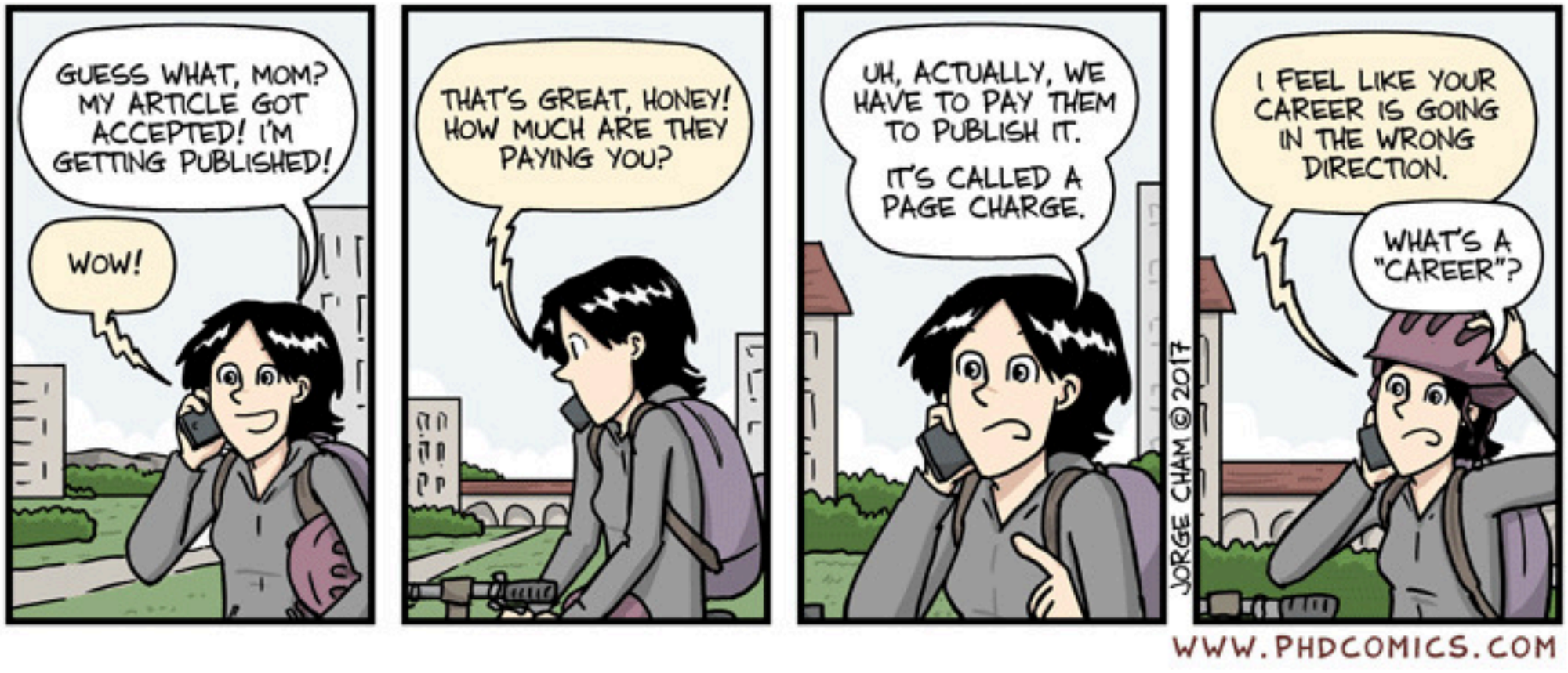
Physics 4601

scientific papers

James C. (JC) Gumbart

http://simbac.gatech.edu/phys4601/

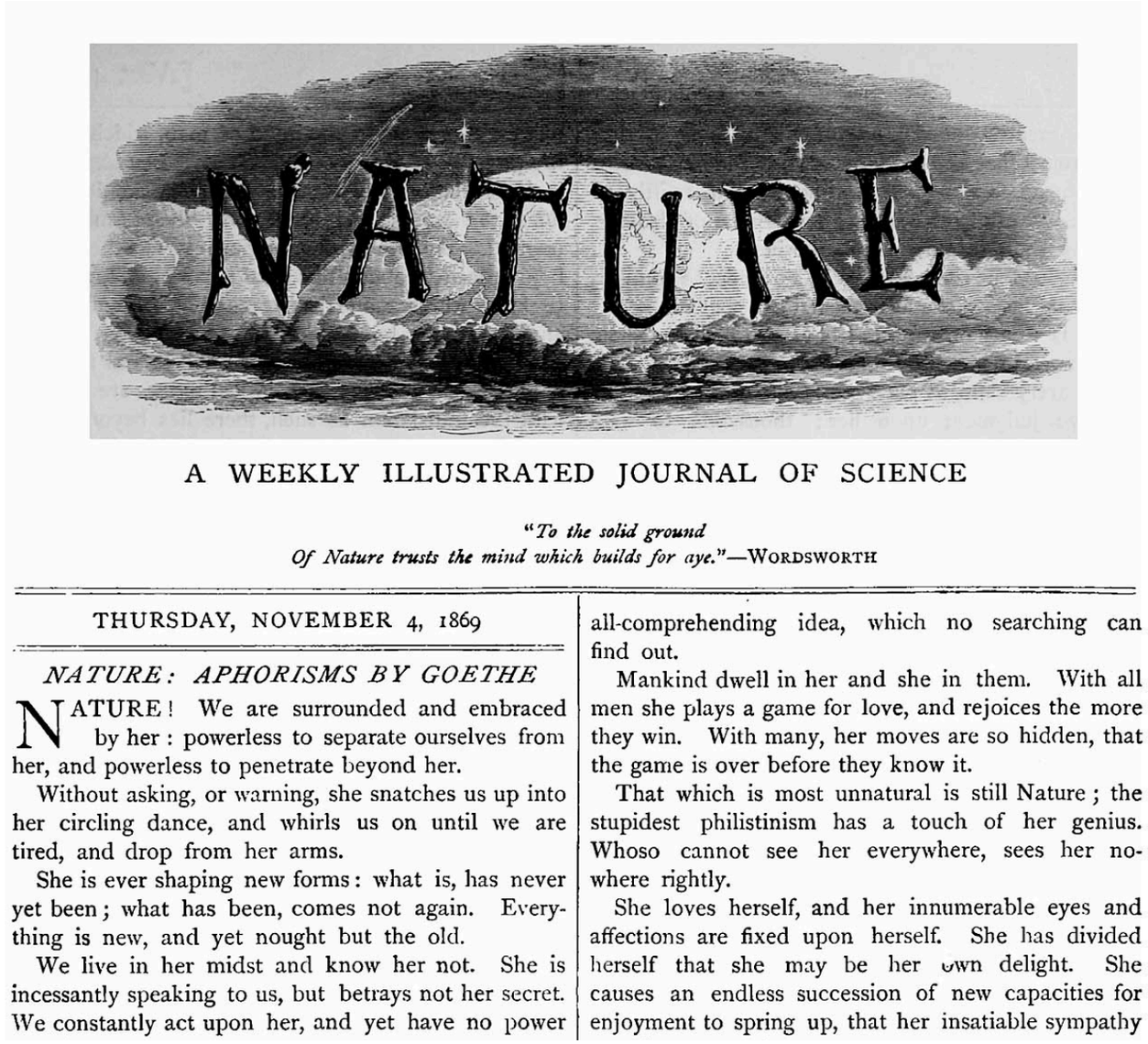


School of Physics | Georgia Tech | Spring 2024

*with inspiration from Simon Sponberg (GT)

Publications are the “currency” of science

- scientific publications are how we communicate new results
- papers are grouped together in journals
- started in 1665 with the French ***Journal des sçavans*** and the English ***Philosophical Transactions of the Royal Society***
- There are now 30,000 journals (estimated), organized around a variety of topics and a range of generalness
- all scientists are expected to publish regularly, with the rate highly dependent on the field (“publish or perish”)
- a person’s publication record encapsulates their career up to that point



NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

“To the solid ground
Of Nature trusts the mind which builds for aye.”—WORDSWORTH

THURSDAY, NOVEMBER 4, 1869

NATURE: APHORISMS BY GOETHE

NATURE! We are surrounded and embraced by her: powerless to separate ourselves from her, and powerless to penetrate beyond her.

Without asking, or warning, she snatches us up into her circling dance, and whirls us on until we are tired, and drop from her arms.

She is ever shaping new forms: what is, has never yet been; what has been, comes not again. Everything is new, and yet nought but the old.

We live in her midst and know her not. She is incessantly speaking to us, but betrays not her secret. We constantly act upon her, and yet have no power all-comprehending idea, which no searching can find out.

Mankind dwell in her and she in them. With all men she plays a game for love, and rejoices the more they win. With many, her moves are so hidden, that the game is over before they know it.

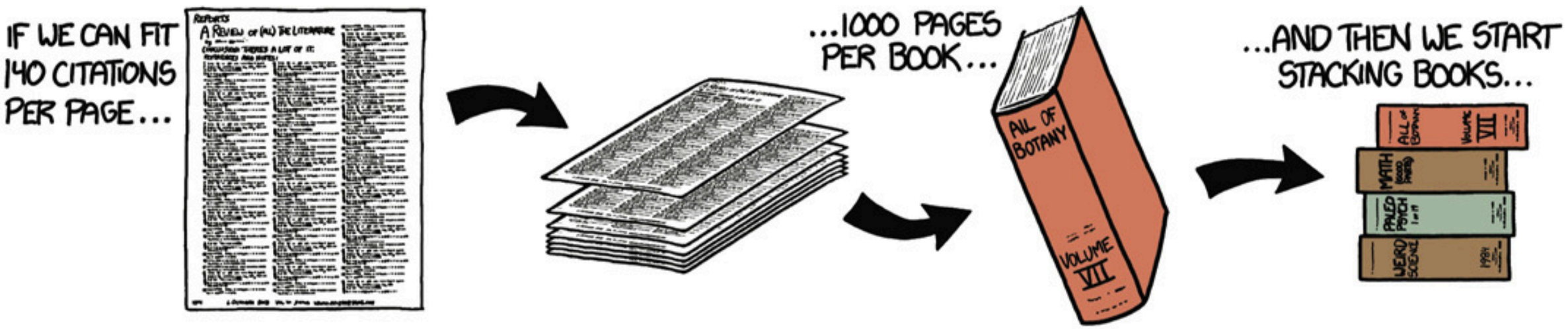
That which is most unnatural is still Nature; the stupidest philistinism has a touch of her genius. Whoso cannot see her everywhere, sees her nowhere rightly.

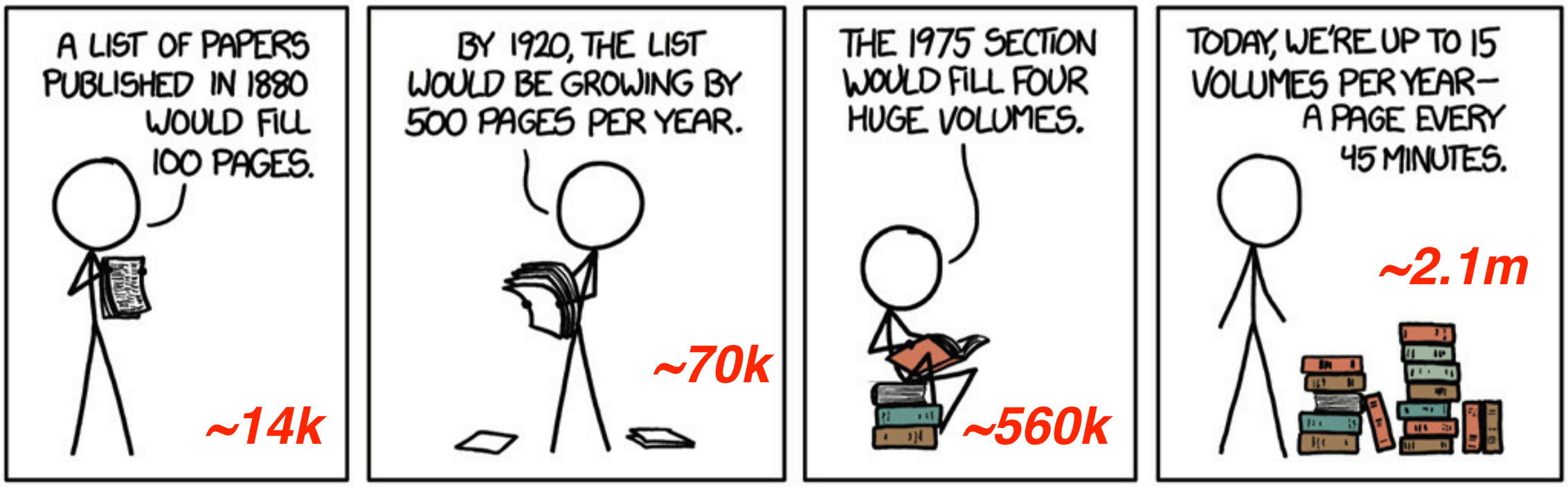
She loves herself, and her innumerable eyes and affections are fixed upon herself. She has divided herself that she may be her own delight. She causes an endless succession of new capacities for enjoyment to spring up, that her insatiable sympathy

cover of first issue of Nature, Nov. 1869

HOW MUCH SCIENCE IS THERE?

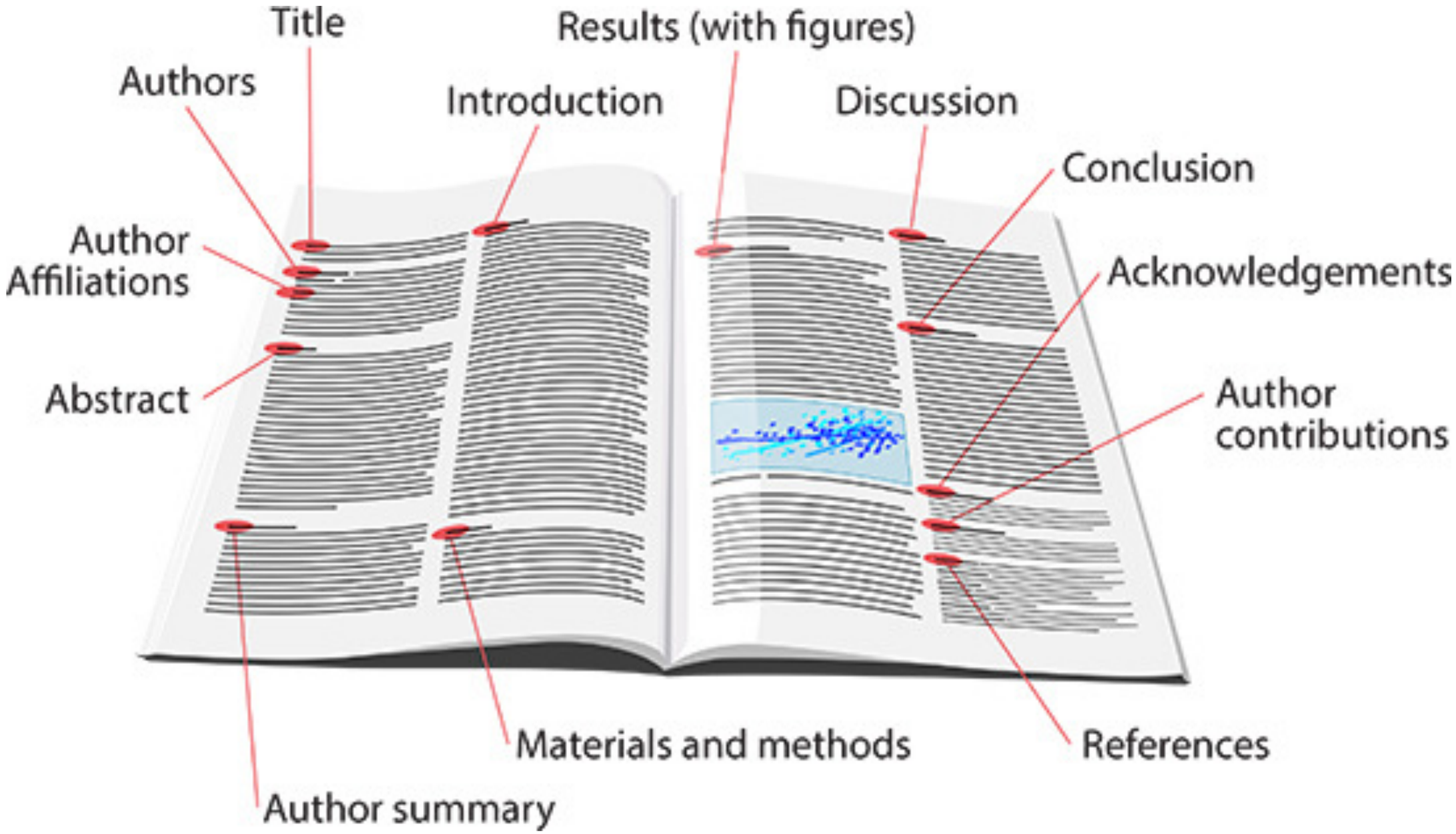
SCIENTIFIC PUBLISHING HAS BEEN ACCELERATING—A NEW PAPER IS NOW PUBLISHED ROUGHLY EVERY 20 SECONDS.
LET'S IMAGINE A BIBLIOGRAPHY LISTING *EVERY* SCHOLARLY PAPER EVER WRITTEN.
HOW LONG WOULD IT BE?





https://www.sciencemag.org/site/special/scicomm/index.xhtml

Anatomy of a paper



despite the plethora of journals and distinct formats, all papers have a basically similar structure with only minor variations, e.g., methods after the introduction or at the end

https://askabiologist.asu.edu/explore/anatomy-of-an-artic

Anatomy of a paper

author order is field dependent!

by contribution

alphabetical

Biophysical *Journal*
Article

Biophysical Society

The Contribution of the Ankyrin Repeat Domain of TRPV1 as a Thermal Module

Ernesto Ladrón-de-Guevara,[1] Laura Dominguez,[2] Gisela E. Rangel-Yescas,[1] Daniel A. Fernández-Velasco,[3] Alfredo Torres-Larios,[4] Tamara Rosenbaum,[4] and Leon D. Islas[1,*]

[1]Facultad de Medicina, Departamento de Fisiología, [2]Facultad de Química, Departamento de Fisicoquímica, [3]Facultad de Medicina, Departamento de Bioquímica, and [4]Instituto de Fisiología Celular, Universidad Nacional Autónoma de México, Mexico City, Mexico

ABSTRACT The TRPV1 cation nonselective ion channel plays an essential role in thermosensation and perception of other noxious stimuli. TRPV1 can be activated by low extracellular pH, high temperature, or naturally occurring pungent molecules such as allicin, capsaicin, or resiniferatoxin. Its noxious thermal sensitivity makes it an important participant as a thermal sensor in mammals. However, details of the mechanism of channel activation by increases in temperature remain unclear. Here, we used a combination of approaches to try to understand the role of the ankyrin repeat domain (ARD) in channel behavior. First, a computational modeling approach by coarse-grained molecular dynamics simulation of the whole TRPV1 embedded in a phosphatidylcholine and phosphatidylethanolamine membrane provides insight into the dynamics of this channel domain. Global analysis of the structural ensemble shows that the ARD is a region that sustains high fluctuations during dynamics at different temperatures. We then performed biochemical and thermal stability studies of the purified ARD by the means of circular dichroism and tryptophan fluorescence and demonstrate that this region undergoes structural changes at similar temperatures that lead to TRPV1 activation. Our data suggest that the ARD is a dynamic module and that it may participate in controlling the temperature sensitivity of TRPV1.

SIGNIFICANCE This work demonstrates that the temperature-dependent dynamics of the ankyrin repeat domain of TRPV1 channels, as probed by coarse-grained molecular dynamics, correspond to the experimentally determined dynamics of an isolated ankyrin repeat domain domain. These results show that this region of TRPV1 channels undergoes significant conformational change as a function of increased temperature and suggest that it participates in the temperature-dependent structural changes that lead to the channel opening.

INTRODUCTION

TRPV1 is a nonspecific cation channel implicated in nociception by chemicals, temperature, and pH (1–3). This channel is one of the chemosensors involved in the sensation of pain and thermal stimuli, and it participates in a diverse range of cellular processes (4,5). The latter has been evidenced from studies in which the deletion of TRPV1 in mice alters noxious and mild temperature sensation (6,7), whereas knockout of other thermo-TRPs such as TRPV2, TRPV3, and TRPV4 shows little effect in sensory transduction in rodents (6,8,9). Moreover, whereas deletion of TRPV1 in rodents does not affect corporal temperature, blockage of TRPV1 in vivo triggers hyperthermia (10).

The rat TRPV1 structure is a tetramer (Fig. 1 *a*), with every monomer consisting of 838 amino acids (Fig. 1 *c*). The structure solved by cryo-EM is from a minimal-functional TRPV1 that lacks 100 amino acids from the N-termini and 80 amino acids in the C-termini and which is also missing a longer S5-pore extracellular loop named the turret. This minimal-functional 586 amino acid construct provides a model for the full-length channel, although without unfolded loops. In TRPV1, the structure of the membrane-embedded domains is canonical with other ion channels like voltage-gated potassium, sodium, and calcium ion channels. A tetramer is formed by a voltage sensor-like domain (VSD)-like domain, surrounding a pore formed by the contribution of the four pore domains (PD) of each subunit.

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*Correspondence: leon.islas@gmail.com
Editor: Baron Chanda.
https://doi.org/10.1016/j.bpj.2019.10.041
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PHYSICAL REVIEW LETTERS **124,** 071801 (2020)

Editors' Suggestion | Featured in Physics

New Physics Implications of Recent Search for $K_L \to \pi^0\nu\bar{\nu}$ at KOTO

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[2]*Institute for Advanced Research & Kobayashi-Maskawa Institute for the Origin of Particles and the Universe, Nagoya University, Nagoya 464–8602, Japan*
[3]*Department of Physics, Florida State University, Tallahassee, Florida 32306, USA*
[4]*High Energy Accelerator Research Organization (KEK), Tsukuba 305-0801, Japan*
[5]*Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 7610001, Israel*
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(Received 21 November 2019; revised manuscript received 15 January 2020; accepted 15 January 2020; published 19 February 2020)

The KOTO experiment recently reported four candidate events in the signal region of $K_L \to \pi^0\nu\bar{\nu}$ search, where the standard model only expects 0.10 ± 0.02 events. If confirmed, this requires physics beyond the standard model to enhance the signal. We examine various new physics interpretations of the result including these: (1) heavy new physics boosting the standard model signal, (2) reinterpretation of "$\nu\bar{\nu}$" as a new light long-lived particle, or (3) reinterpretation of the whole signal as the production of a new light long-lived particle at the fixed target. We study the above explanations in the context of a generalized new physics Grossman-Nir bound coming from the $K^+ \to \pi^+\nu\bar{\nu}$ decay, bounded by data from the E949 and the NA62 experiments.

DOI: 10.1103/PhysRevLett.124.071801

Introduction.—Despite being one of the greatest successes of theoretical physics, it is clear that the standard model (SM) is not a complete description of nature. One of the best ways to search for new physics (NP) beyond the SM is to look for events that are predicted to be extremely rare in the SM by a theoretically clean calculation. An observation of just a few such events could then constitute a robust evidence of NP. From this perspective, rare decays of K mesons via a flavor changing neutral current and/or a CP violation (CPV) provide ideal probes of NP as they are highly suppressed in the SM and are theoretically clean [1].

Two golden channels are the $K_L \to \pi^0\nu\bar{\nu}$ and $K^+ \to \pi^+\nu\bar{\nu}$ decay processes. Within the SM, these are suppressed by a loop factor, the GIM mechanism [2], and the CKM elements, and predicted to have branching ratios smaller than 10^{-10} [3–5]. These processes are being currently probed by the KOTO and the NA62 experiments, both aim to reach the corresponding SM sensitivity. Recently, the KOTO experiment gave a status report for $K_L \to \pi^0\nu\bar{\nu}$ search [6], and the NA62 experiment announced new preliminary result for $K^+ \to \pi^+\nu\bar{\nu}$ search [7].

Strikingly, the KOTO experiment presented data on four candidate events in the signal region of the $K_L \to \pi^0\nu\bar{\nu}$ search, where the SM expectation is a mere 0.10 ± 0.02 events [6] (0.05 ± 0.01 signal and 0.05 ± 0.02 background). While one of the events is suspected as a background from an upstream activity, the remaining three events are quite distinct from presently known backgrounds. In this Letter, we assume that these three events are signals and explore implications, although taking four events as signal would not essentially affect our NP interpretations.

If the photons and missing energy in the signals are interpreted as $\pi^0\nu\bar{\nu}$, the KOTO single event sensitivity, 6.9×10^{-10} [6], implies (for two-sided limits)

$$\mathcal{B}(K_L \to \pi^0\nu\bar{\nu})_{\mathrm{KOTO}} = 2.1^{+2.0(+4.1)}_{-1.1(-1.7)} \times 10^{-9}, \quad (1)$$

at the 68 (95) % confidence level (CL), statistical uncertainties included. The central value is about two orders of magnitude larger than the SM prediction, $\mathcal{B}(K_L \to \pi^0\nu\bar{\nu})_{\mathrm{SM}} = (3.4 \pm 0.6) \times 10^{-11}$ [3–5], which corresponds to p value at the 10^{-4} level for the SM and background expectations. On the other hand, for the upper bound on the $K^+ \to \pi^+\nu\bar{\nu}$ decay rate, the E949 experiment obtained $\mathcal{B}(K^+ \to \pi^+\nu\bar{\nu}) < 3.35 \times 10^{-10}$ at 90% CL [8,9], while the recent preliminary update [7] by the NA62 experiment is

$$\mathcal{B}(K^+ \to \pi^+\nu\bar{\nu})_{\mathrm{NA62}} = 0.47^{+0.72}_{-0.47}(< 2.44) \times 10^{-10}, \quad (2)$$

at the 68 (95) % CL for two-sided (one-sided) limit, consistent the SM prediction of $\mathcal{B}(K^+ \to \pi^+\nu\bar{\nu}) = (8.4 \pm 1.0) \times 10^{-11}$

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typical paper

typical letter (few, or even no sections!)

How to read a paper?

> **Every week I would sit with the article, read every single sentence, and then discover that I hadn't learned a single thing.**

https://www.sciencemag.org/careers/2016/01/how-read-scientific-paper

do **NOT** read a paper from start to finish!

How to read a paper?

there's a ton of advice out there - here is my approach

- start with the title and abstract
- look at the figures next - do they make sense?
- IF you are not an expert in this area, look at the introduction to understand the context of their work (if you are an expert, you can circle back to this part later)
- read the discussion/conclusions - what do they think are their most important results?
- read the results - do their conclusions follow convincingly from their data?
- finally, read the methods

The "paper box" (from Heather Lerner, Earlham) provides a structure to help you get organized

Your Name:_____ Article (Author, Year, Journal): _____

AUDIENCE

Journal Description

Who is the target audience for this paper?

Is this in a specialized journal or are the authors writing for a broader audience? Is this a review article that is written for a newcomer to the field?

BROAD IMPORTANCE

Discussion/Conclusion

How is this research broadly important to the field and to society?

Describe both types of contribution. Focus on **interpretation** of the results and their **application** to other study systems and to solving problems of importance to society.

SPECIFIC RESEARCH QUESTION

Introduction/Background, sometimes Methods or Results

What is the testable hypothesis or hypotheses (including the null hypothesis)?

Make clear exactly what is being measured/compared, including species names, and any spatial and temporal components.

MAJOR RESEARCH FINDING(S)

Results or **Results and Discussion**

What are the most important (i.e. major) research findings described in the paper?

List 2-3 **major** research findings. Be selective. Look for results that are novel, well-supported, and answer the specific research question(s) from above. Note: negative results can be important!

DATA COLLECTION AND ANALYSIS

Methods Section

How were the data gathered and what methods are used to analyze the data?

Describe the dataset, specifically the **type** of samples collected and the **number** of samples.

Also list or describe the way the samples were analyzed, being careful to focus on the **method** (e.g. Bayes statistics) rather than the name of the software (e.g. Mr. Bayes) or other equipment.

PREVIOUS KNOWLEDGE

Introduction/Background

What are the 2-3 most important known ideas or pieces of information that led to this study?

Describe the key findings from other research that inspired this project. It's a good idea to also put a short citation with each finding (i.e. author, year) but a citation should not replace the description of the findings.

EXISTING GAP

Introduction/Background

What is the gap in knowledge this project aims to contribute to filling?

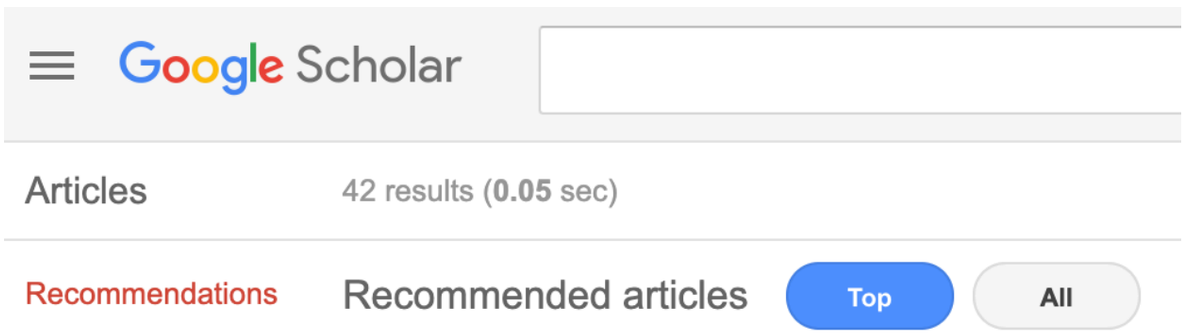
This is often described as the BIG remaining question(s) in the field, though it does not need to be stated as a question. This is almost never a directly testable hypothesis because it is a big and broad area of research.

Your Name:_____ Article (Author, Year, Journal): _____

AUDIENCE	SPECIFIC RESEARCH QUESTION	PREVIOUS KNOWLEDGE
	MAJOR RESEARCH FINDING(S)	
BROAD IMPORTANCE		EXISTING GAP
	DATA COLLECTION AND ANALYSIS	

How to find papers of interest

- a biophysicist might regularly read *Biophysical Journal*, a chemist *Journal of the American Chemical Society*, and so on
- However, now, most people find papers in ways other than just skimming the Table of Contents for a few journals



- **Google Scholar alerts**

- **Journal-specific and arXiv alerts on specific topics**

arXiv / Help / To Subscribe to the E-Mail Alerting Service

To Subscribe to the E-Mail Alerting Service

- **Science twitter**

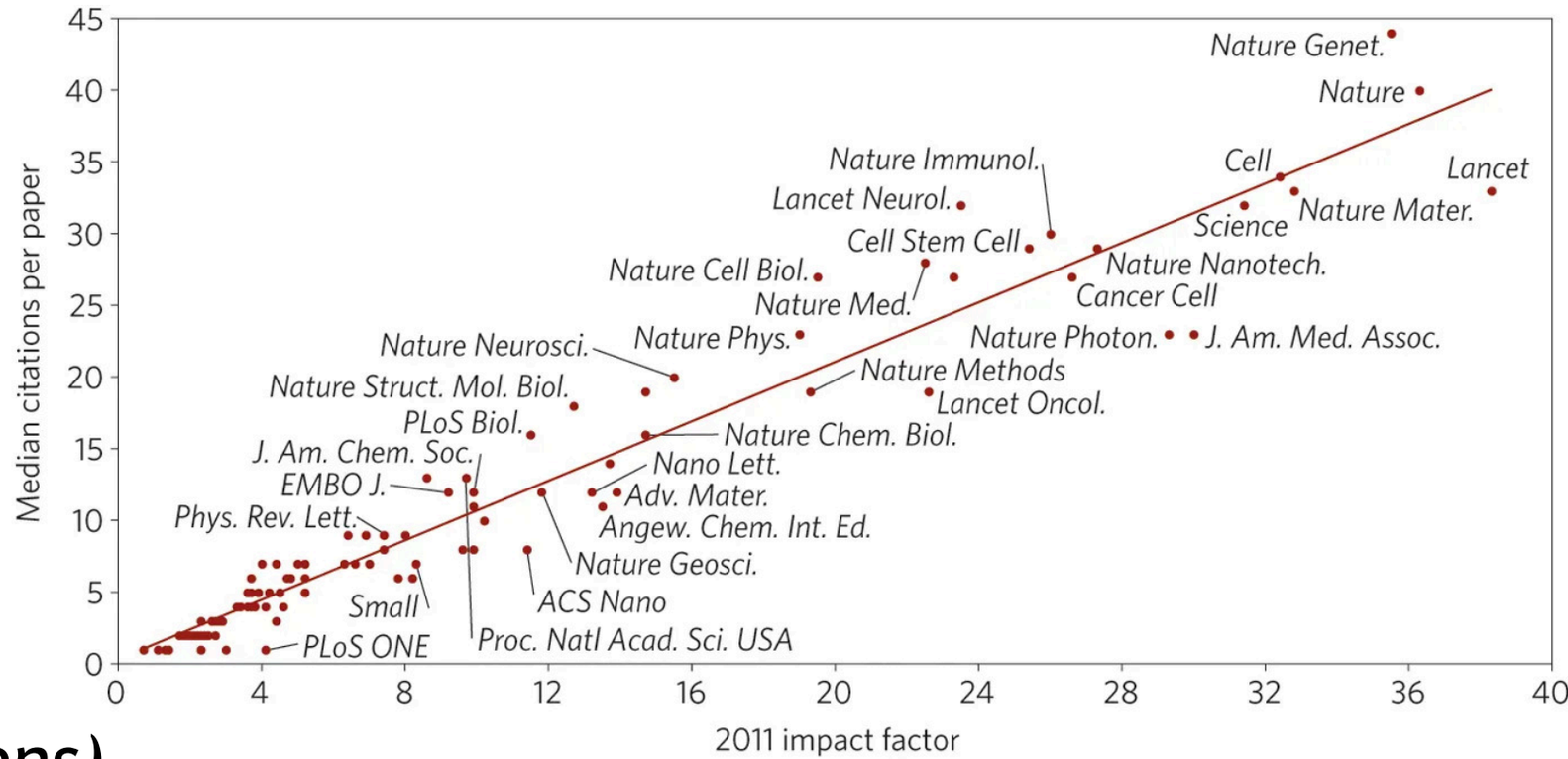
Where to submit your paper?

- **Congratulations!** You have made a scientific discovery!
- first and foremost, you want to publish in a venue where interested people are likely to find your paper (*although less critical than before*)
- typically we aim for the journal with the highest impact factor (IF) that we think will publish it

IF is the ratio of citations in a given year of papers from the previous two years dividing by the number of those papers

$$\mathrm{IF}_y = \frac{\mathrm{Citations}_y}{\mathrm{Publications}_{y-1} + \mathrm{Publications}_{y-2}}.$$

- Top journals (Nature, Science) are around IF 50-70
- Mid-tier are around 10-20
- Society-level journals are often around 5-10



Note: this is field-specific (e.g., math has fewer citations)

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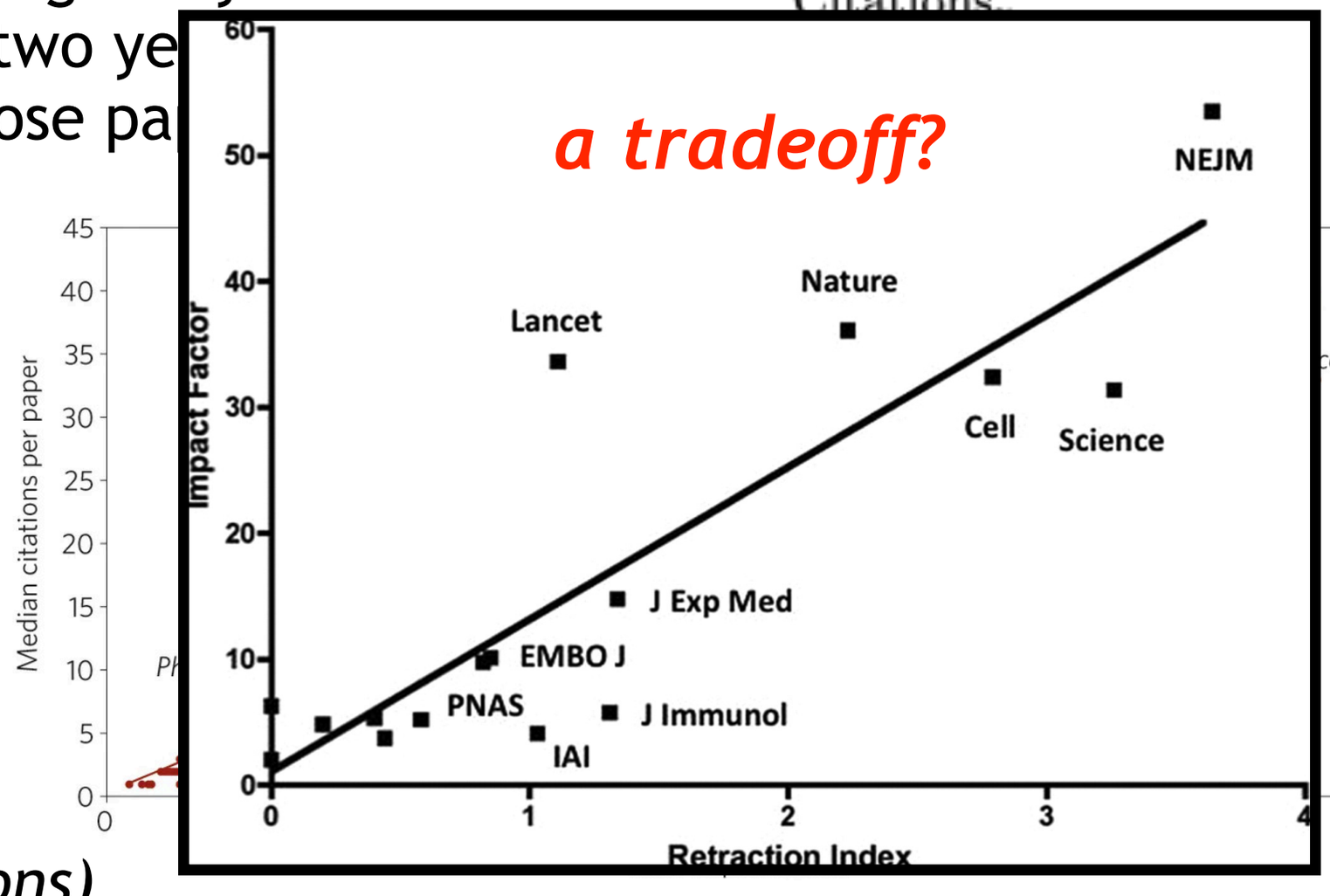


Pre-print servers

- because the time to publication can be quite long (months to a year or more), pre-print servers offer a way to distribute scientific results quickly
- typically before or during submission to a journal, an author can submit their manuscript to a pre-print server, where it will become immediately available with no additional formatting or peer review

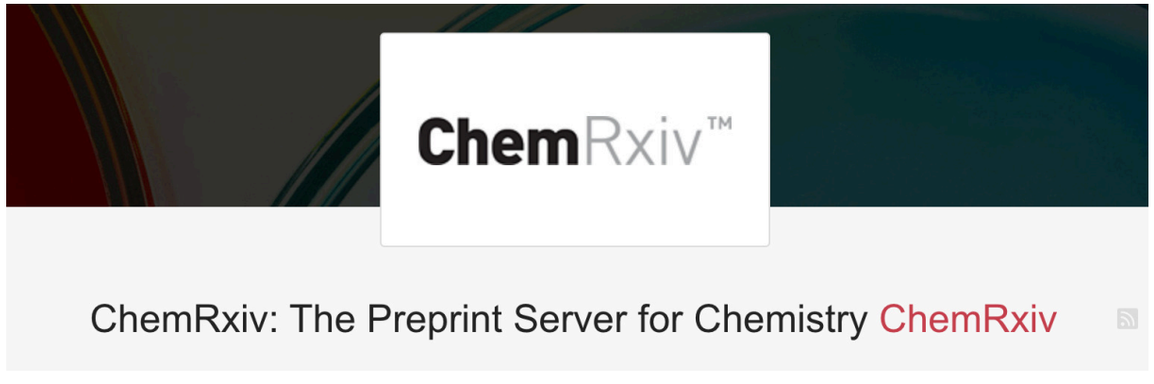
arXiv is the best known, mainly for physics, math, CS (1991)

arXiv.org

arXiv is a free distribution service and an open-access archive for 1,663,887 scholarly articles in quantitative biology, quantitative finance, statistics, electrical engineering and systems science,

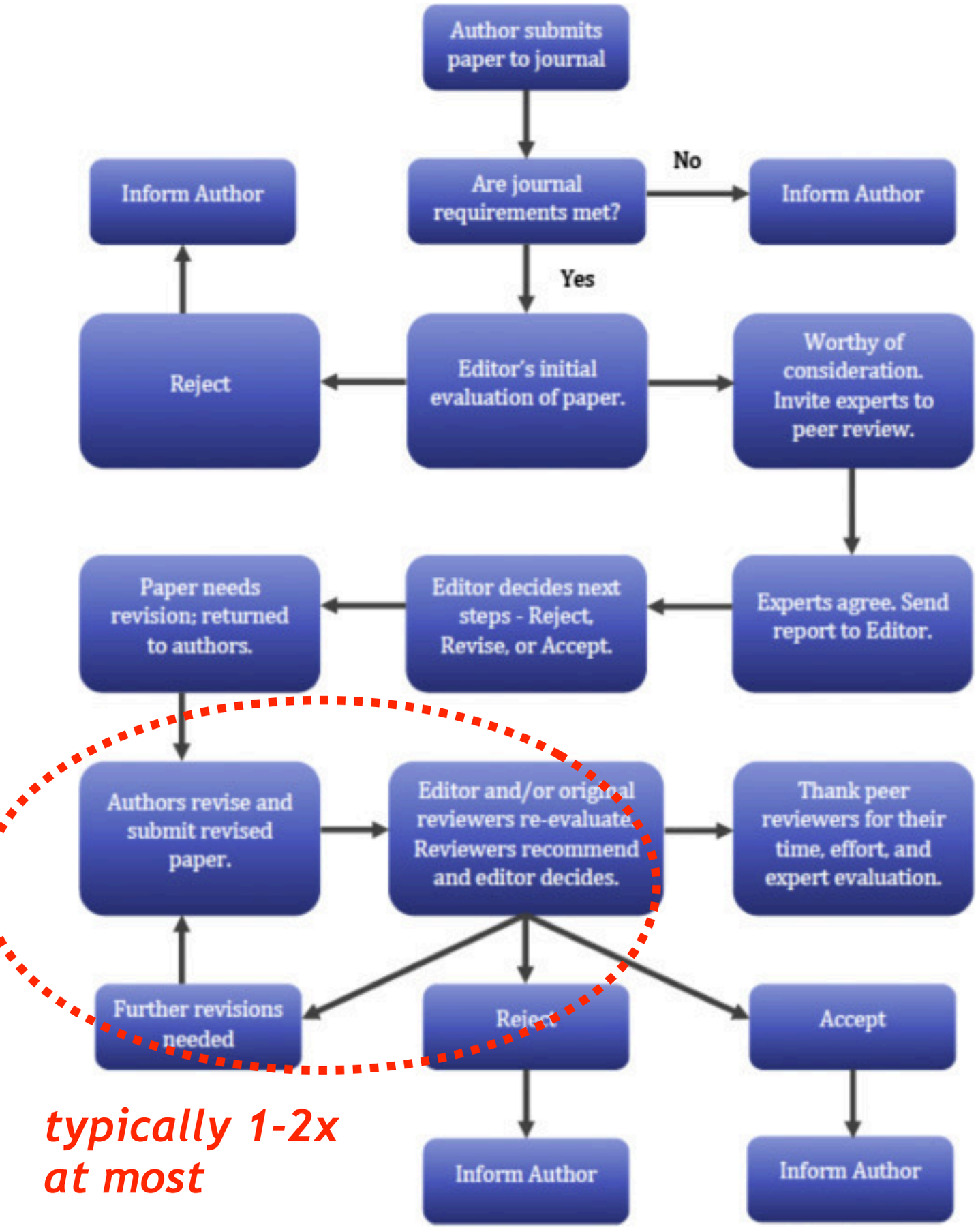
bioRxiv THE PREPRINT SERVER FOR BIOLOGY bioRxiv was created specifically for bio papers (2013)

ChemRxiv (2017)



Bourne PE, Polka JK, Vale RD, Kiley R. Ten simple rules to consider regarding preprint submission. *PLoS Comput Biol*. 2017;13(5):e1005473. doi:10.1371/journal.pcbi.1005473

The process



typically 1-2x at most

Worthy of consideration?
Many papers are rejected at this stage for having insufficient general interest/impact

Timeframe
Journals often given reviewers 2-4 weeks to submit their reviews; sometimes another reviewer is needed to adjudicate a disagreement

Editor's role
Editor reads reviews and makes a decision whether to accept, reject, or ask for revisions

https://www.elsevier.com/reviewers/what-is-peer-review

Peer review

- currently, all* scientific papers are peer reviewed, by 1 (yay!) to 4 (groan!) reviewers (**in legitimate journals*)
- the reviewers evaluate the scientific accuracy and quality (always) as well as the impact (almost all journals)
- surprisingly, peer review only became common in the mid 20th century

Even Einstein bristled at his paper being peer reviewed by *Physical Review* (1936)!

> *Dear Sir,*
>
> *We (Mr. Rosen and I) had sent you our manuscript for publication and had not authorized you to show it to specialists before it is printed. I see no reason to address the in any case erroneous comments of your anonymous expert. On the basis of this incident I prefer to publish the paper elsewhere.*
>
> *Respectfully,*
>
> *P.S. Mr. Rosen, who has left for the Soviet Union, has authorized me to represent him in this matter.*

Historical note: the reviewer was correct!

A universal truth: reviewer #3 is loathed

Cost to publish?

- publishing is rarely free - either the author or the reader pays (sometimes both!)
- author charges can range widely, from $500 (*Biophysical Journal*) to $6790 (*Nature Communications*)
- Open-access journals like *PLoS* ____ charge ~$1700-$3000

- some journals, like those of the American Chemical Society are all free to publish in but charge huge subscription fees

- although subscriptions are negotiated and private, they represent a huge chunk of the library's budget

Institutions are pushing back!

- UC system canceled their $11 million contract with Elsevier in 2019

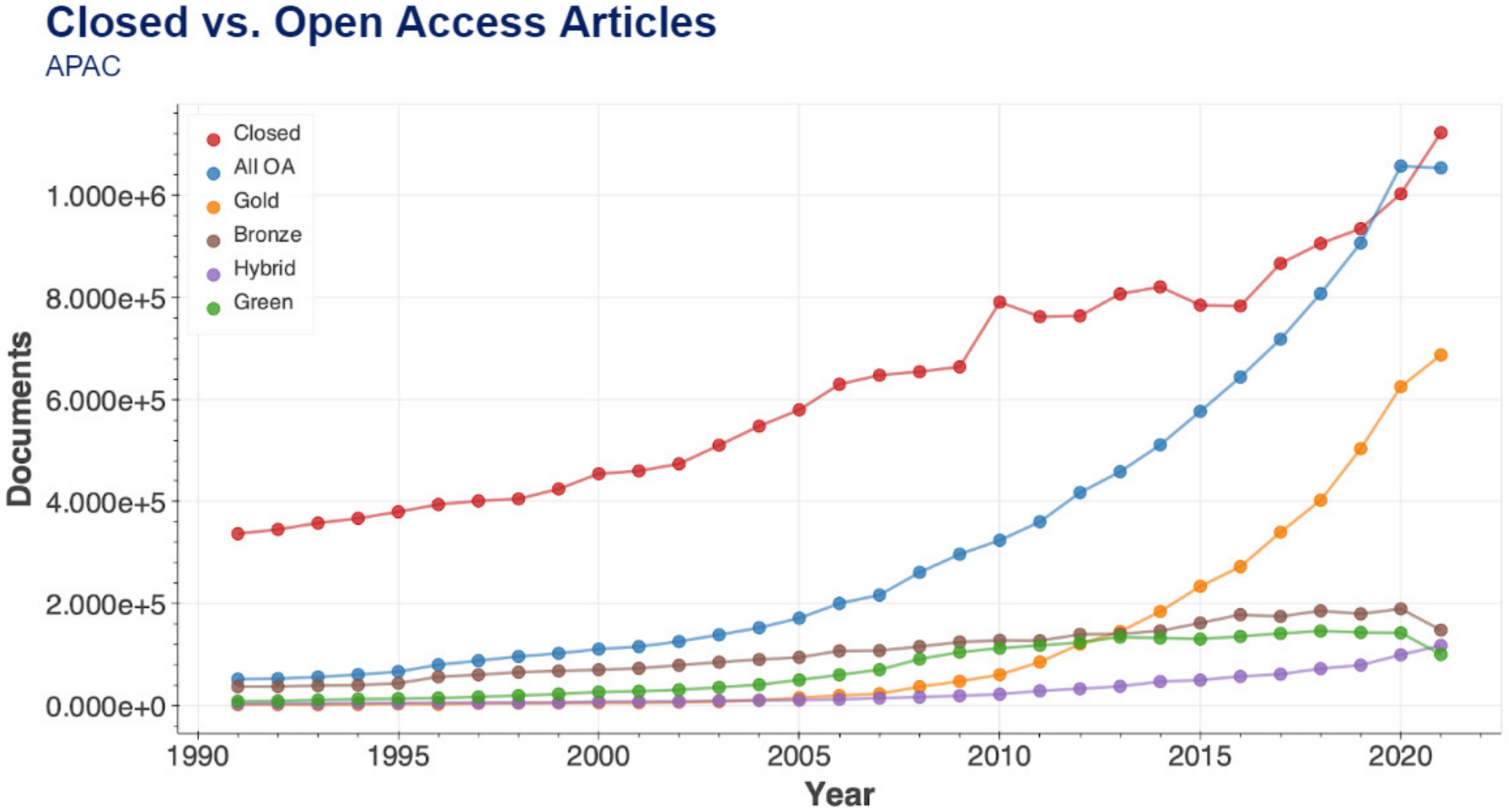
https://www.sciencemag.org/news/2019/02/university-california-boycotts-publishing-giant-elsevier-over-journal-costs-and-open

- They renegotiated the deal in 2021 to the tune of $13 million

https://www.universityofcalifornia.edu/news/ucs-deal-elsevier-what-it-took-what-it-means-why-it-matters

“Open access”

- pre-internet, scientific journals were real publications, printed on paper and distributed at some cost
- now, while many are still printed (albeit at smaller numbers), many more are distributed online only
- with distribution costs approaching zero, some journals moved to a model in which final papers are made freely available to read



“Open access”

- one of the most well known open-access publishers is the Public Library of Science (PLoS), a non-profit founded in 2000
- all major publishers now have at least one “open access” journal (with large publication fees!)

nature COMMUNICATIONS

PRX

“Open access”

- many major funders make open access a condition of funding
- National Institutes of Health has a database called PubMed Central in which all NIH-funded publications are made available within 12 months (but lacking the journal-specific formatting)

- NSF now has a similar requirement, although it’s not as well known still
- Many European funding agencies have organized around a “Plan S” to make all funded work be openly accessible, and cap publication fees, paid by the funder

https://www.sciencemag.org/news/2019/01/will-world-embrace-plan-s-radical-proposal-mandate-open-access-science-papers

Predatory publishing

Dear Dr. Gumbart

Good Morning.

You must be having a busy day, so I wouldn't want to take much of your time.

I am Sana Anjum, Associate managing editor for eMedical Research journal, writing this email to invite you to contribute a manuscript for upcoming issue of the journal.

All submissions will undergo anonymous review to guarantee high scientific quality and relevance to the subject. The issue will be published in first half of 2020, which means that we will need your manuscript by **April 05th, 2020**.

To view further details about journal, click here

Note: The manuscripts funded by NIH will be available on PubMed after its online publication

If you have any questions or concerns, don't hesitate to let me know.

Yours Sincerely,

Sana Anjum
Associate Managing Editor,
eMedical Research
E-mail: sanaanjum@emresonline.org

This is the majority of my email every morning!
(plus scam conferences)

However, some are not as obvious!

Predatory publishing: Warning signs

- Flattering emails, poor language, etc.
- Journal title is similar to a respectable publication but mixed
- Website is amateurish, unprofessional
- No standard metrics, indexing (e.g., DOI)
- No verified impact factor (see Journal Citation Reports)
- Article process is unclear, lack transparency about fees

https://libguides.rutgers.edu/predatory

- One great resource to check is Beall's List* https://beallslist.net/

NATURE | NEWS

Controversial website that lists 'predatory' publishers shuts down

Librarian Jeffrey Beall won't say why he has unpublished his widely read blog.

Andrew Silver

18 January 2017 | Corrected: 18 January 2017

https://www.nature.com/news/controversial-website-that-lists-predatory-publishers-shuts-down-1.21328

*Jeffrey Beall deactivated the list after threat of lawsuits, but it lives on in other ways

https://en.wikipedia.org/wiki/Beall%27s_List