



Cold Spring Harbor Laboratory

# Professionalizing Training

## Origin Stories for the Modern Researcher

Jason Williams

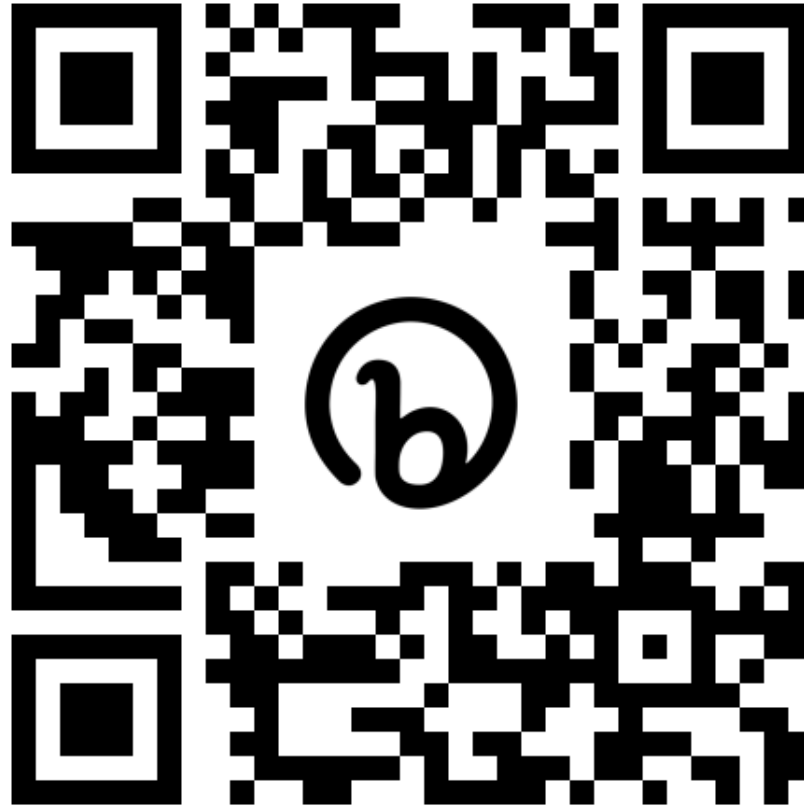
Cold Spring Harbor Laboratory, DNA Learning Center



@JasonWilliamsNY

Australian Research Data Commons Skills Summit – Feb 2023

# Slide Download



[https://bit.ly/ardc\\_feb2023](https://bit.ly/ardc_feb2023)

# Cold Spring Harbor Laboratory



# CSHL DNA Learning Center



Hands on education in molecular biology/bioinformatics for secondary students (Grade 6-12); secondary and undergraduate faculty training; websites/multimedia







Middle school programs

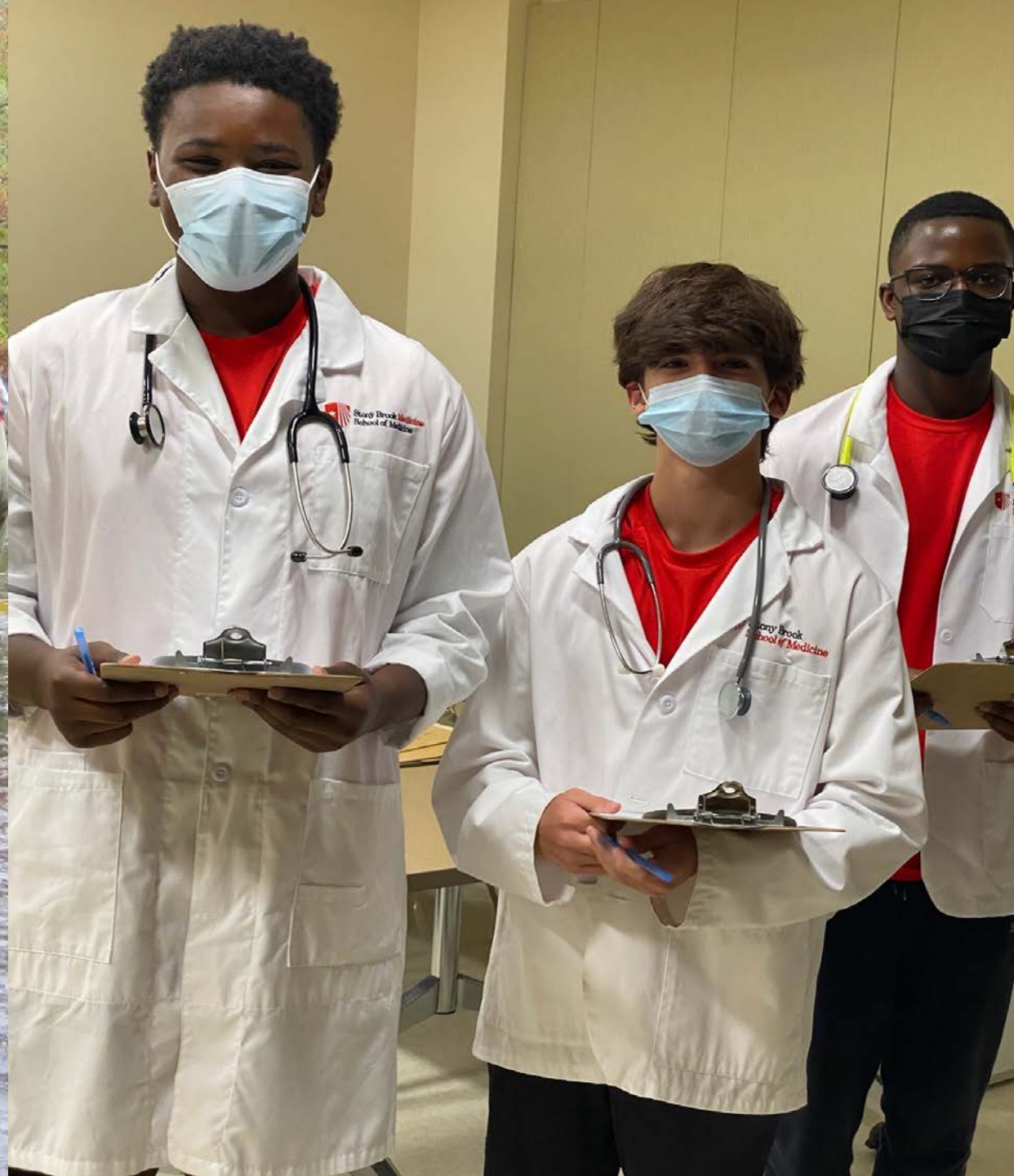


High school programs





Project-based and mentoring







Faculty training





Online education



# DNA FROM THE BEGINNING

An animated primer of 75 experiments that made modern genetics.

CLASSICAL GENETICS

MOLECULES OF GENETICS

GENETIC ORGANIZATION AND CONTROL

*DNA from the Beginning* is organized around key concepts.

The science behind each concept is explained by:  
animation, image gallery, video interviews, problem, biographies, and links.

ftb blog:

AftB OG

**Hibernation - Why Not Me?**

It's the season of hibernation, something I've always wished I could do. Oh, to wrap up in a ball, sleep away the winter, and wake to a beautiful spring day – like Bambi! Although the thought has always intrigued me, it never really occurred to me what a feat hibernation actually is. It turns out that all of the bears, squirrels, rabbits ... that I thought were just sleeping, are breaking biological laws!! If I was to stay dormant for 5 months, without food or drink and little to no movement in freezing

Feature:

*Weed to Wonder*



We have relaunched the *Weed to Wonder* site as a flexible "e-book" that can be viewed as a website, an app, or a printable PDF.

Mailing List

Sign-up to receive email newsletters on dnalc resources and educational opportunities

Name:

Email:

State:





**DOLAN DNALC**



**HARLEM DNA LAB**



**DNALC NYC**



**DNALC REGENERON**

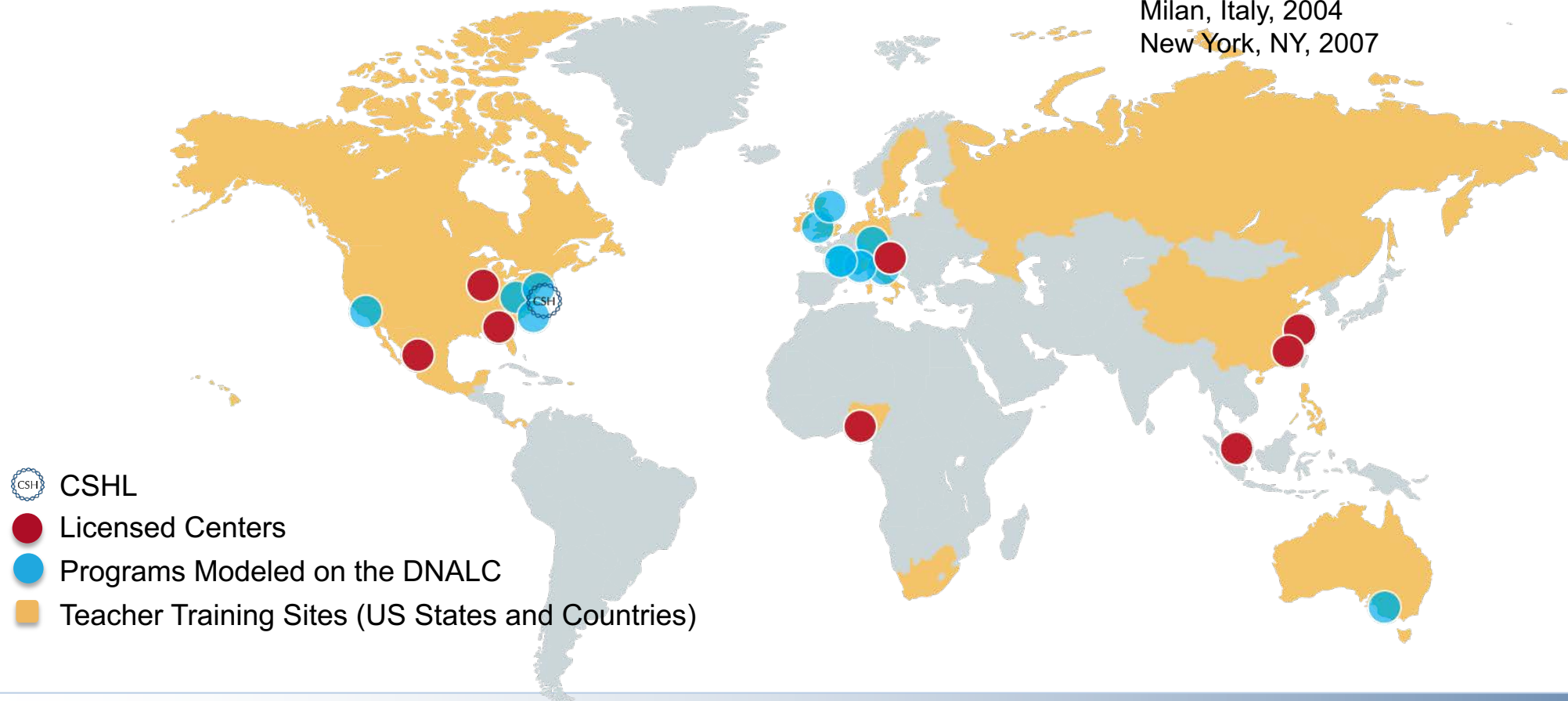


## 4 CSHL Centers 8 Licensed Centers 10 Modeled Programs

Dolan DNALC, 1988  
*Harlem DNA Lab*, 2008  
*Regeneron DNALC*, 2019  
*DNALC NYC*, 2021

Singapore, 2003  
Clemson, SC, 2003  
Vienna, Austria, 2006  
Notre Dame, IN, 2013  
Beijing, China, 2014  
Suzhou, China, 2016  
Enugu, Nigeria, 2019  
Mexico City, Mexico (in Development)

Stony Brook, NY, 1995  
San Francisco, CA, 1996  
Nimes, France, 1998  
Berlin, Germany, 1999  
Parkville, Australia, 2000  
Turin, Italy, 2000  
Cambridge, MA, 2002  
Newcastle upon Tyne, UK, 2002  
Milan, Italy, 2004  
New York, NY, 2007

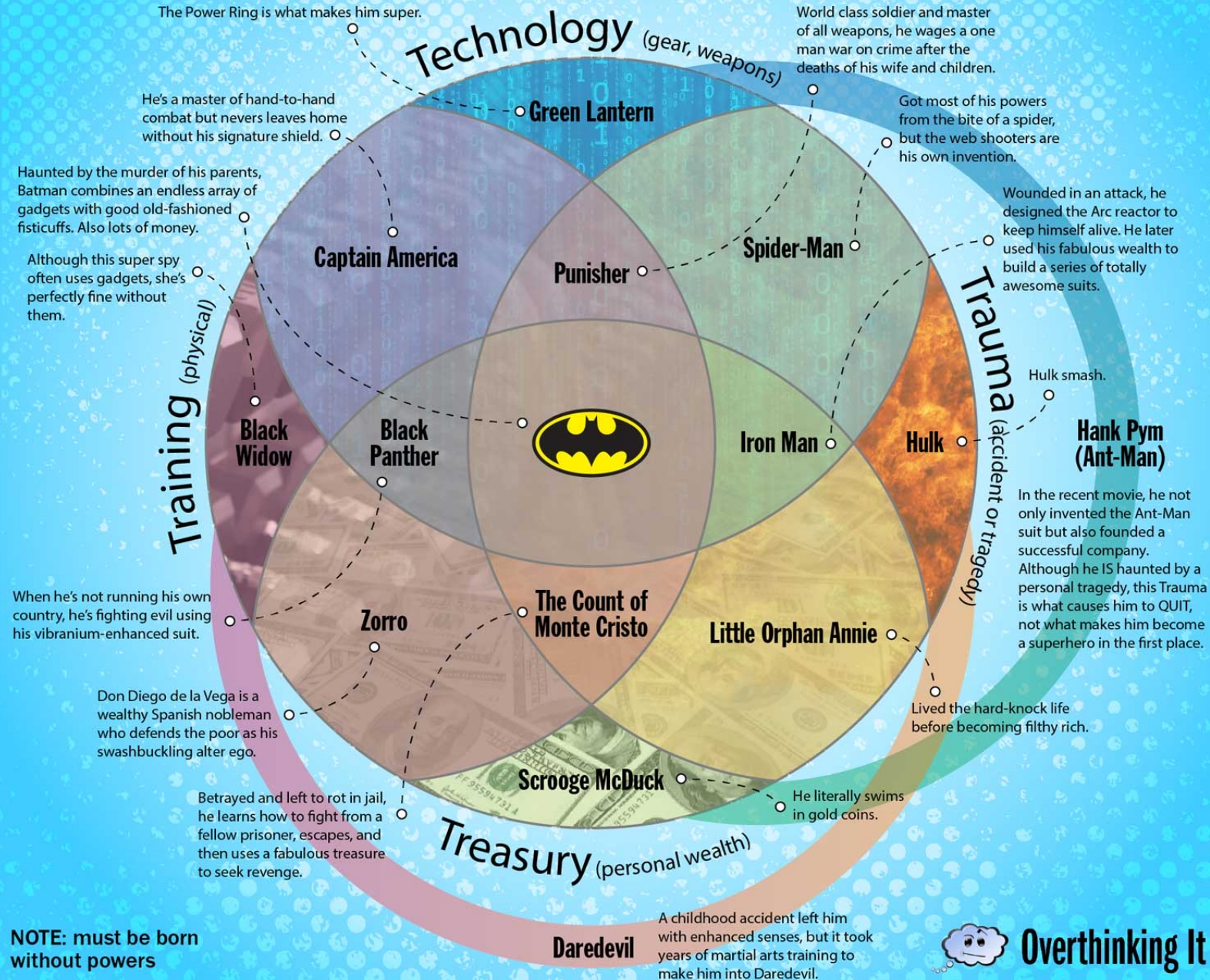


- CSHL
- Licensed Centers
- Programs Modeled on the DNALC
- Teacher Training Sites (US States and Countries)

What makes a (super)hero?



# Superhero Origin Stories



Overthinking It

Academic structures were built  
around the origin stories  
of its “heroes”

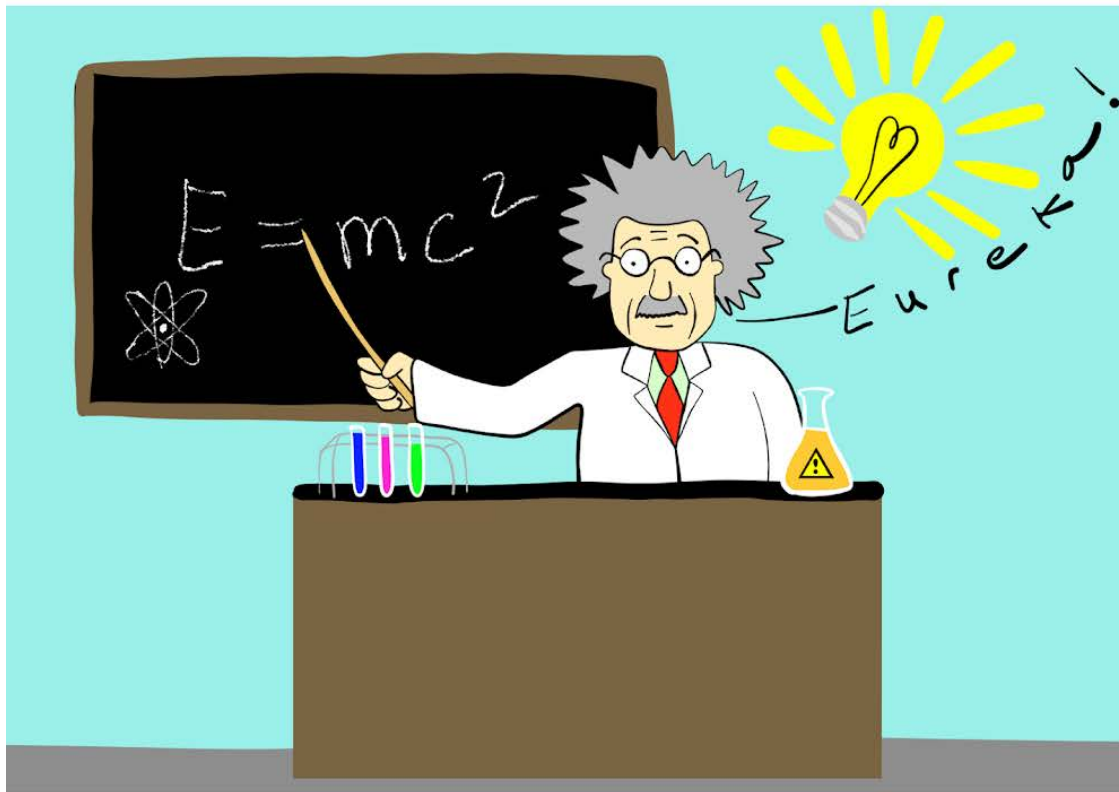






# Researcher Stereotypes

## The Draw-A-Scientist Test



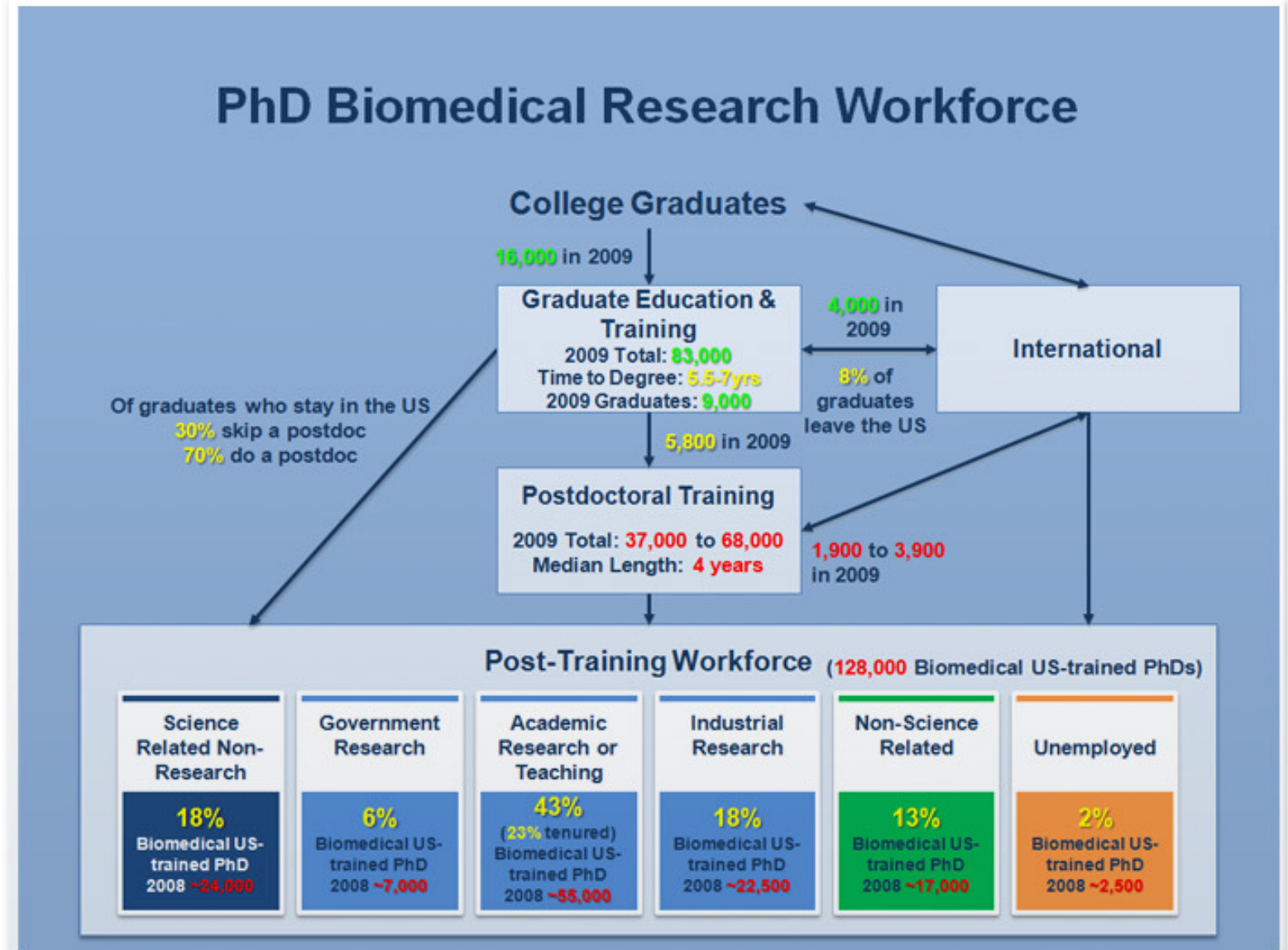
- ☒ Lab coat
- ☒ Eyeglasses
- ☒ Facial hair
- ☒ Symbols of research
- ☒ Technology
- ☒ Relevant caption
- ☒ Male
- ☒ Caucasian
- ☒ Middle-aged or elderly
- ☒ Working indoors
- ☒ Indications of danger





So, What Does the Biomedical Research Workforce Look Like?

“I was quite surprised by the idea that the majority of our trainees do not end up in academia. Did this surprise you?” (SR, 2012)



<https://nexus.od.nih.gov/all/2012/06/22/so-what-does-the-biomedical-research-workforce-look-like/>

How to be a successful researcher...

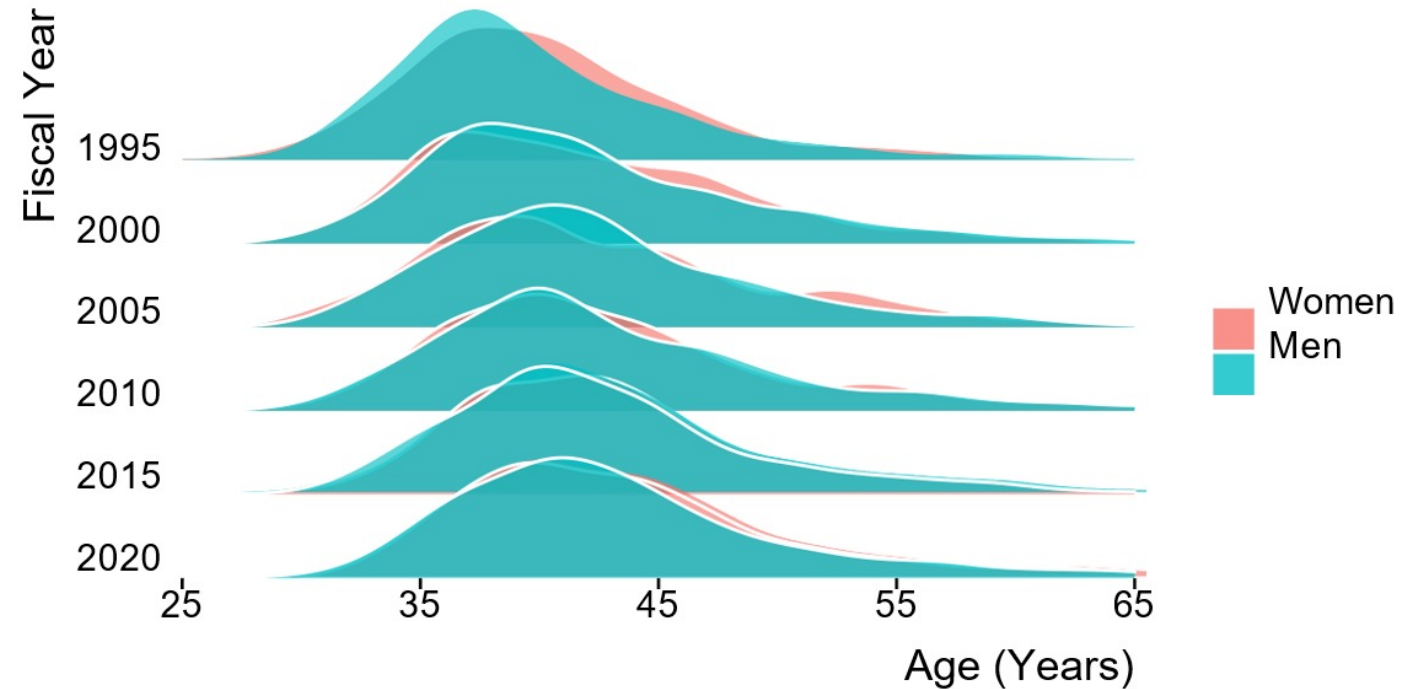


Just be rich...



# Treasury...

## Age of Principal Investigators Supported for the First Time on NIH R01-Equivalent Awards

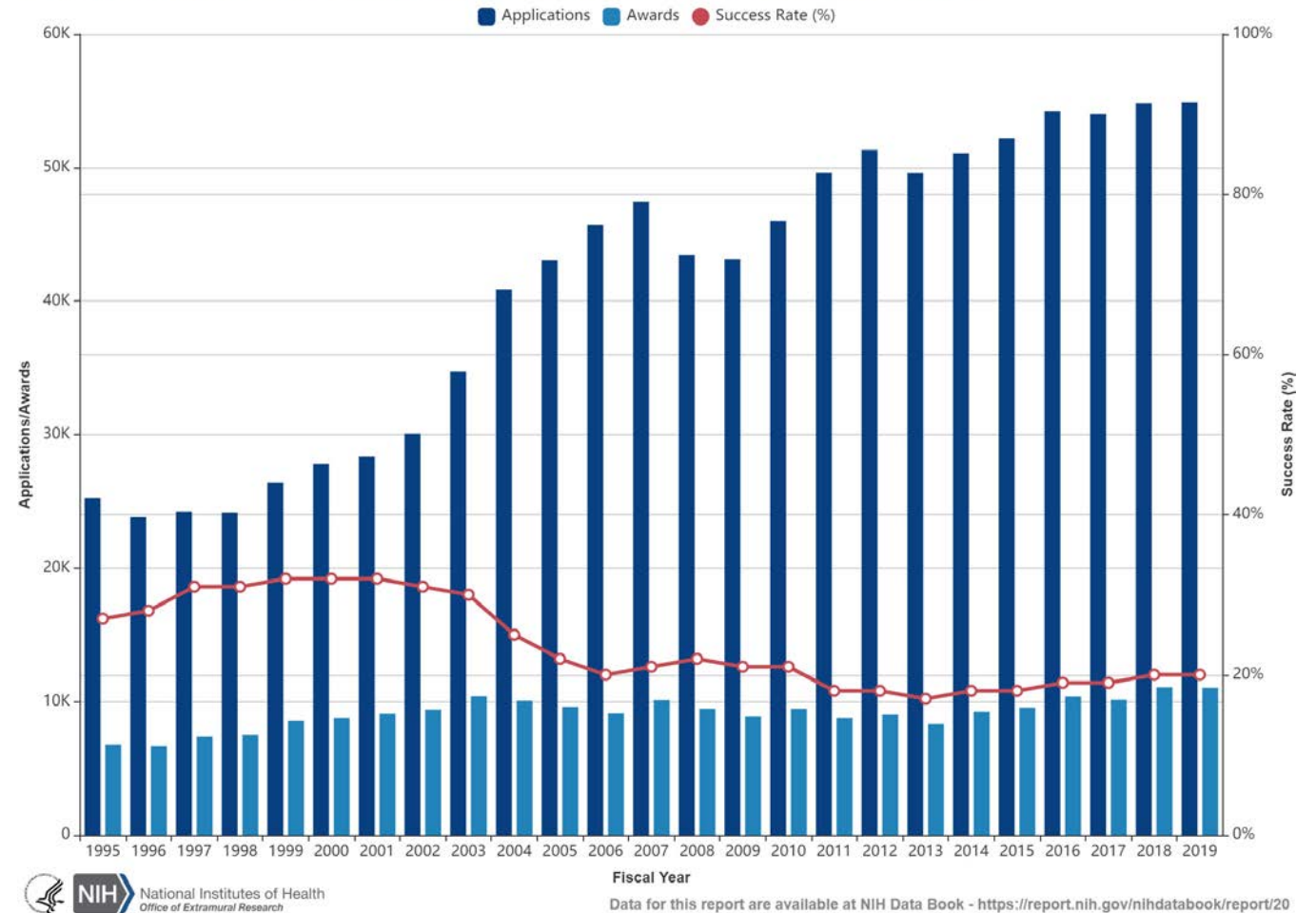


<https://nexus.od.nih.gov/all/2021/11/18/long-term-trends-in-the-age-of-principal-investigators-supported-for-the-first-time-on-nih-r01-awards/>



# Treasury...

Research Project Grants: Competing Applications, Awards, and Success Rates



<https://www.nih.gov/news-events/nih-research-grants-digital-press-kit>

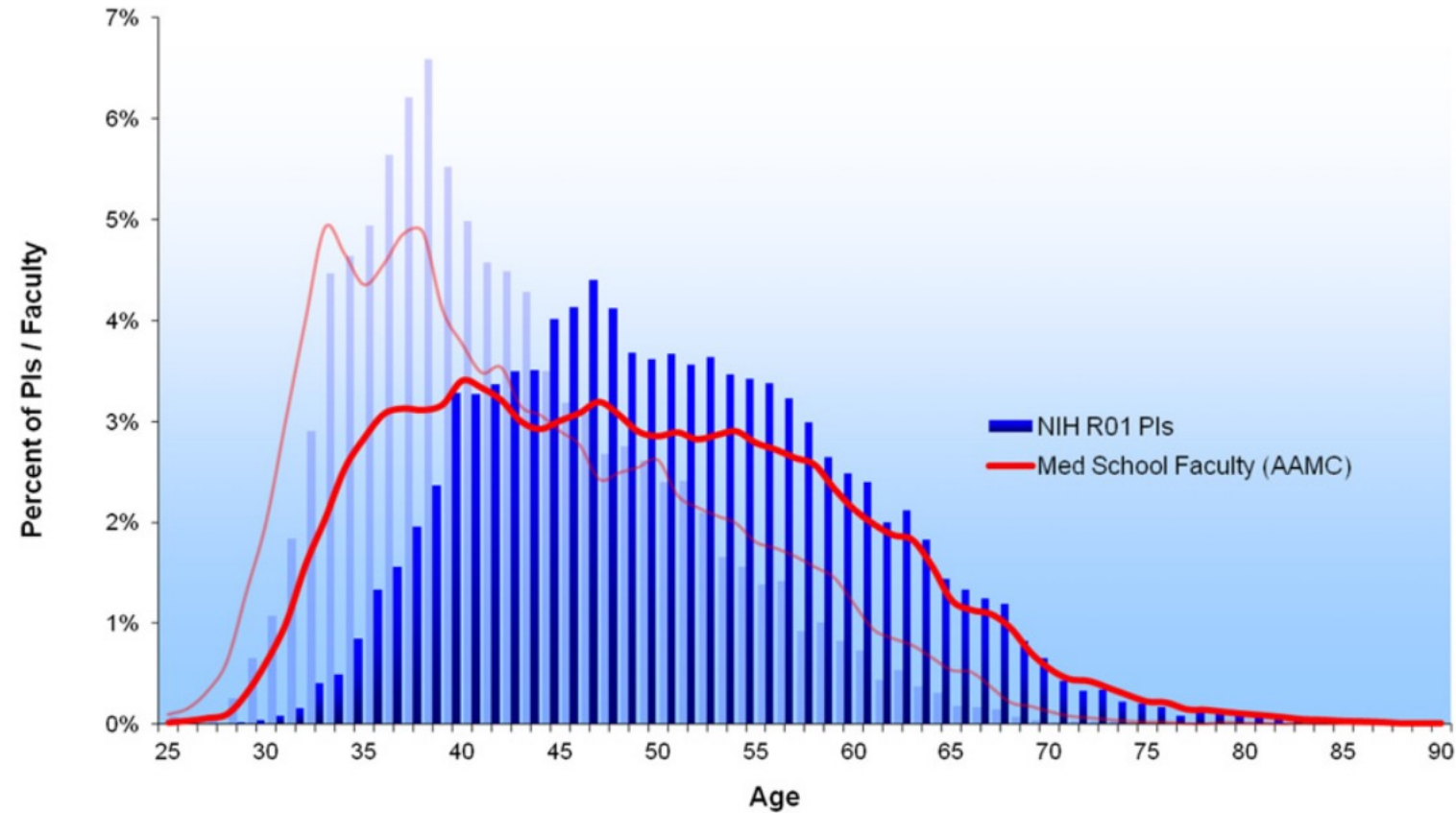
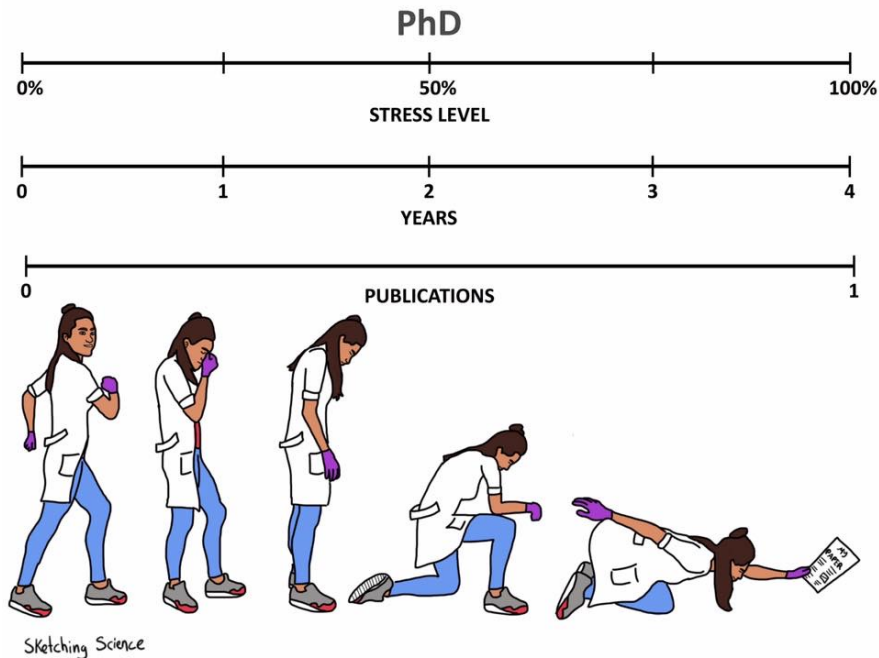


Just endure the  
pain...





# Trauma...



**Fig. 1.** Percent of NIH R01 principal investigators and medical school faculty by age (1980 in pale and 2010 in bold). Image from ref. 5.

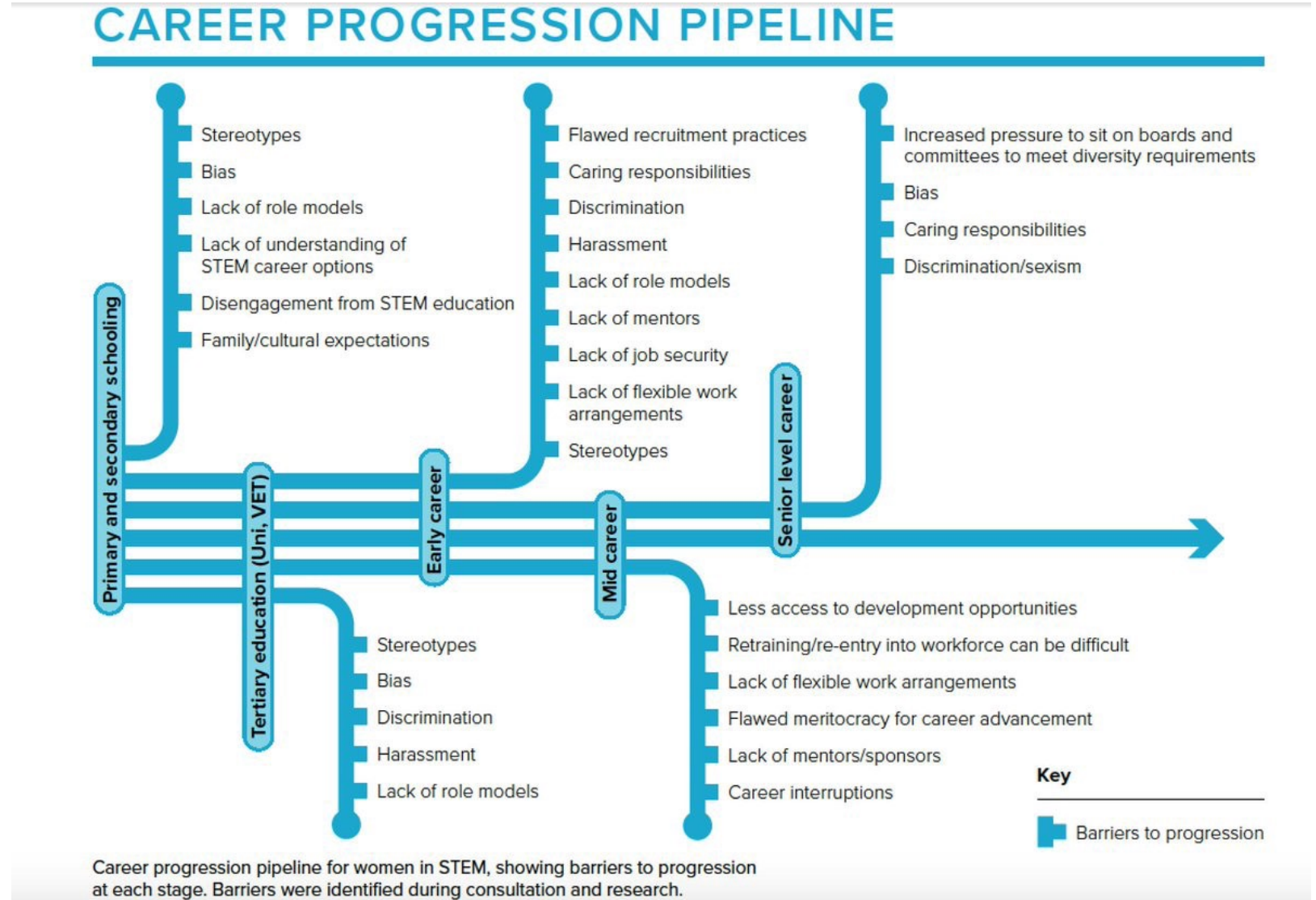
## A generation at risk: Young investigators and the future of the biomedical workforce

**Ronald J. Daniels<sup>1</sup>**

President, Johns Hopkins University, Baltimore, MD 21287

Edited by Inder M. Verma, The Salk Institute for Biological Studies, La Jolla, CA, and approved December 8, 2014 (received for review September 29, 2014)

# Trauma...



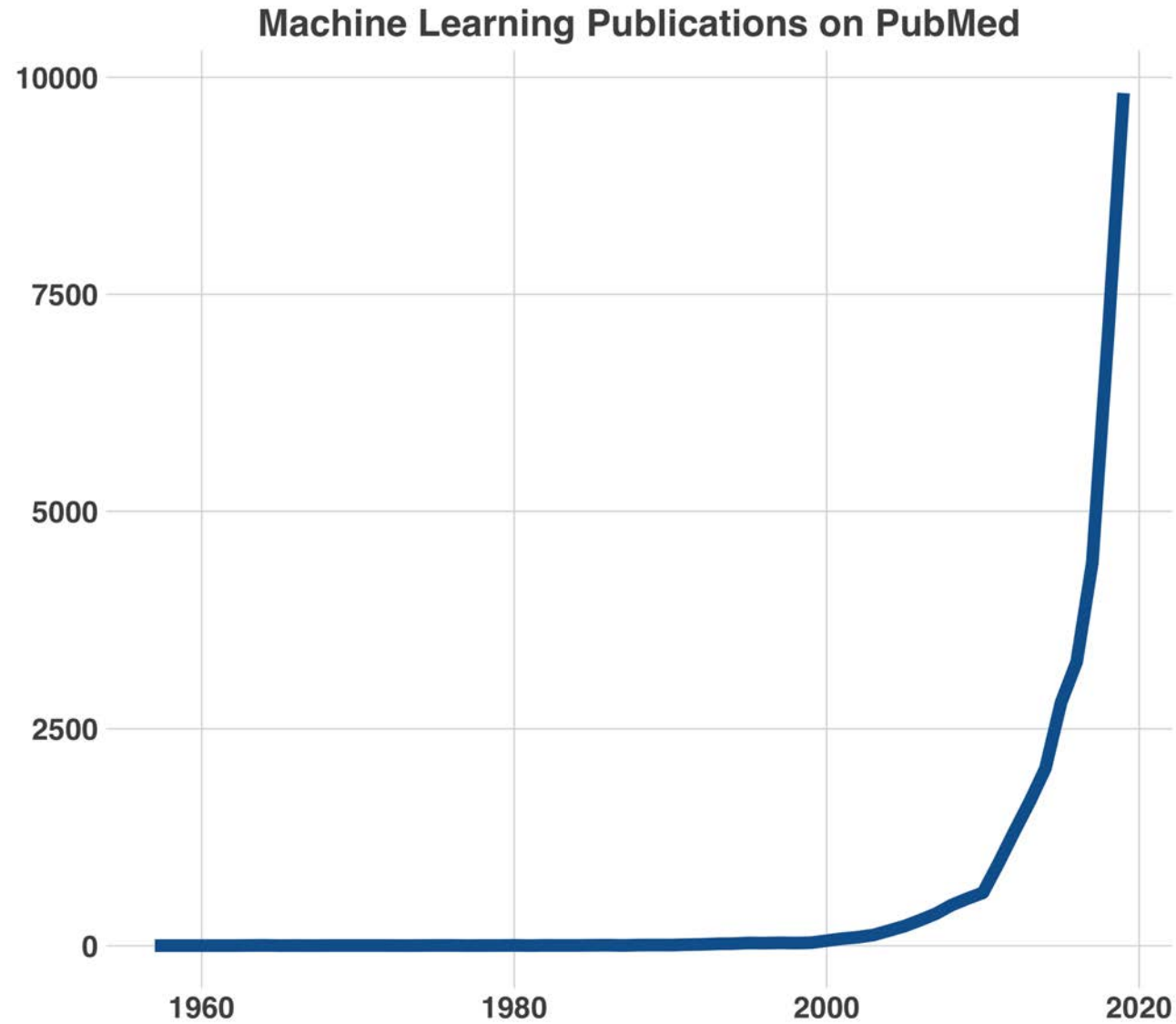
A STEM career progression pipeline showing barriers to progression at each stage. From [Australian Academy of Science \(@Science\\_Academy\)](#).



Have the  
technology...



# Technology...





# Technology...

Conferences > 2022 IEEE Symposium on Visual... ?

## "There's no way to keep up!": Diverse Motivations and Challenges Faced by Informal Learners of ML

**Publisher: IEEE**

[Cite This](#)

 **PDF**

[Rimika Chaudhury](#) ; [Philip J. Guo](#) ; [Parmit K. Chilana](#) **All Authors**



# Renovations underway

Lots of work to do,  
We see conversations, budgeted roles, progress(?)  
around ...

- Improving /equalizing funding
- Work-life balance
- Diversity, equity, inclusion



What about  
The training...

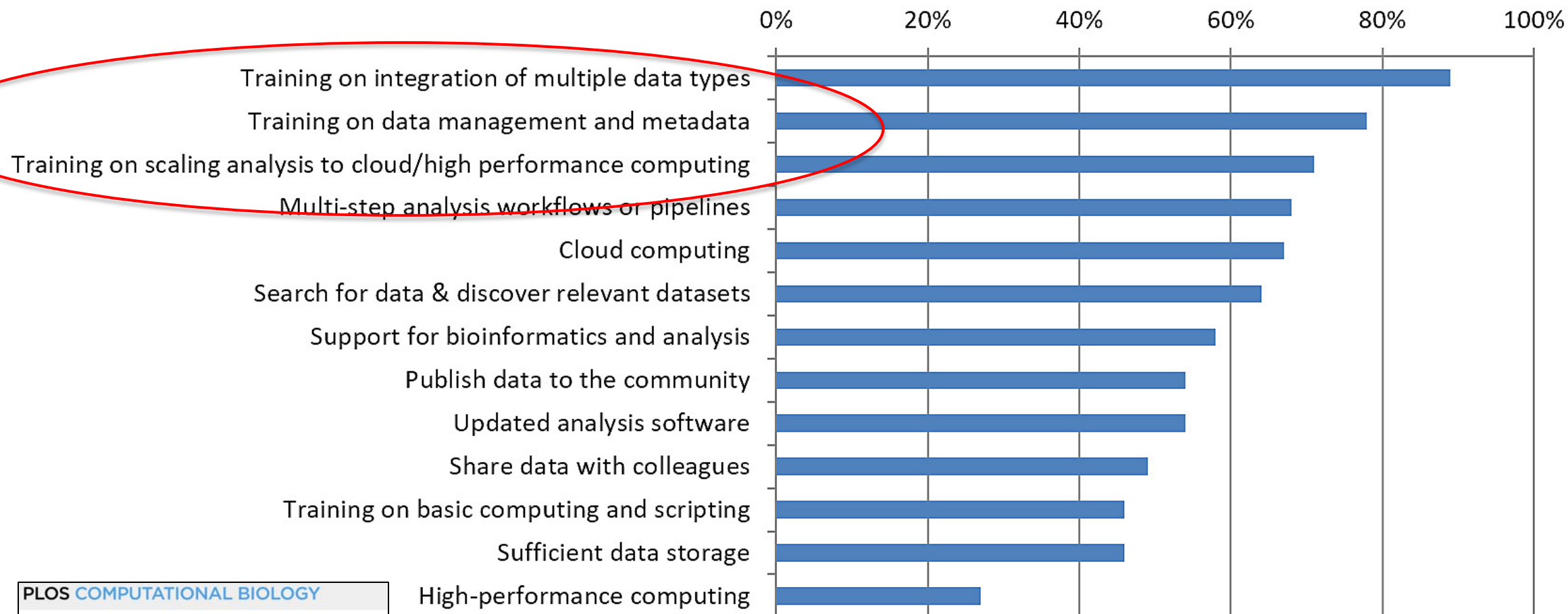


Modern researchers need to get serious  
About career-spanning training





# Training is the biggest need



PLOS COMPUTATIONAL BIOLOGY

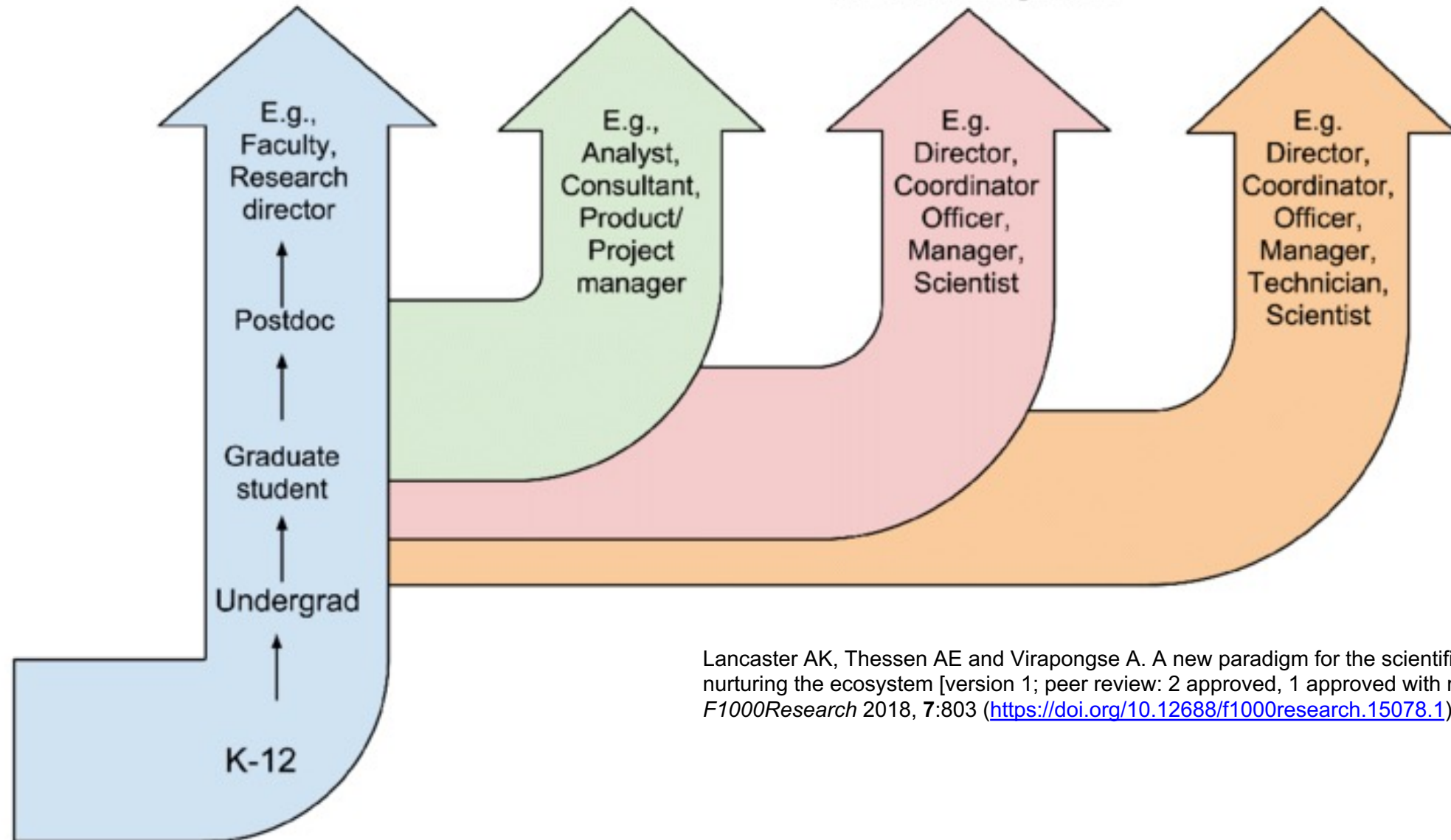
OPEN ACCESS  
EDUCATION

Unmet needs for analyzing biological big data: A survey of 704 NSF principal investigators

Lindsay Barone, Jason Williams, David Micklos



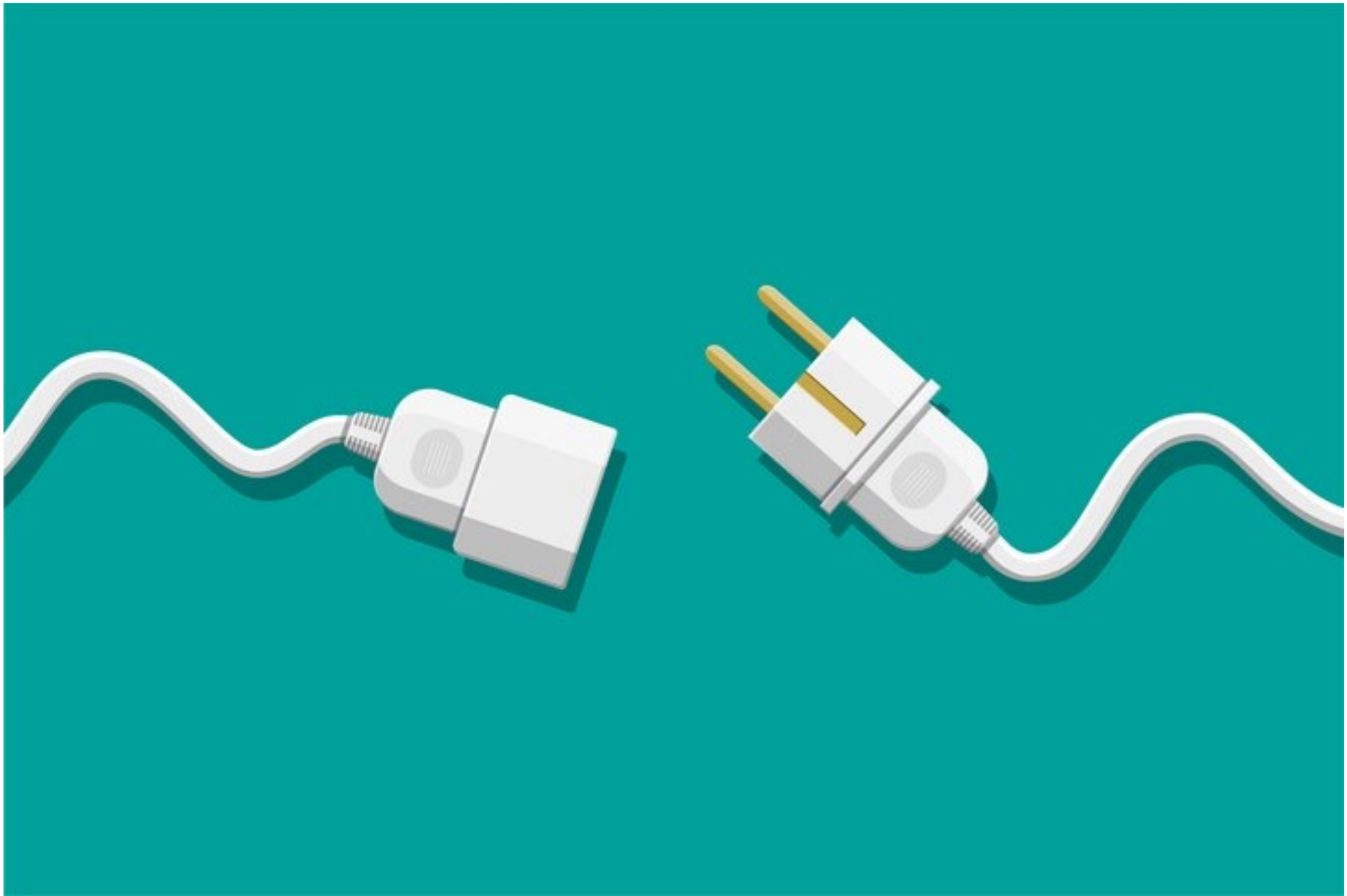
# Training...



Lancaster AK, Thessen AE and Virapongse A. A new paradigm for the scientific enterprise: nurturing the ecosystem [version 1; peer review: 2 approved, 1 approved with reservations]. *F1000Research* 2018, **7**:803 (<https://doi.org/10.12688/f1000research.15078.1>)



# Scientific digital divide?



<https://www.languagemagazine.com/2020/07/18/digital-divide-affecting-education-even-more/>





# Bridging the gap between formal and career-spanning training



# People should be the target to scale

**1980s:**



**2022:**





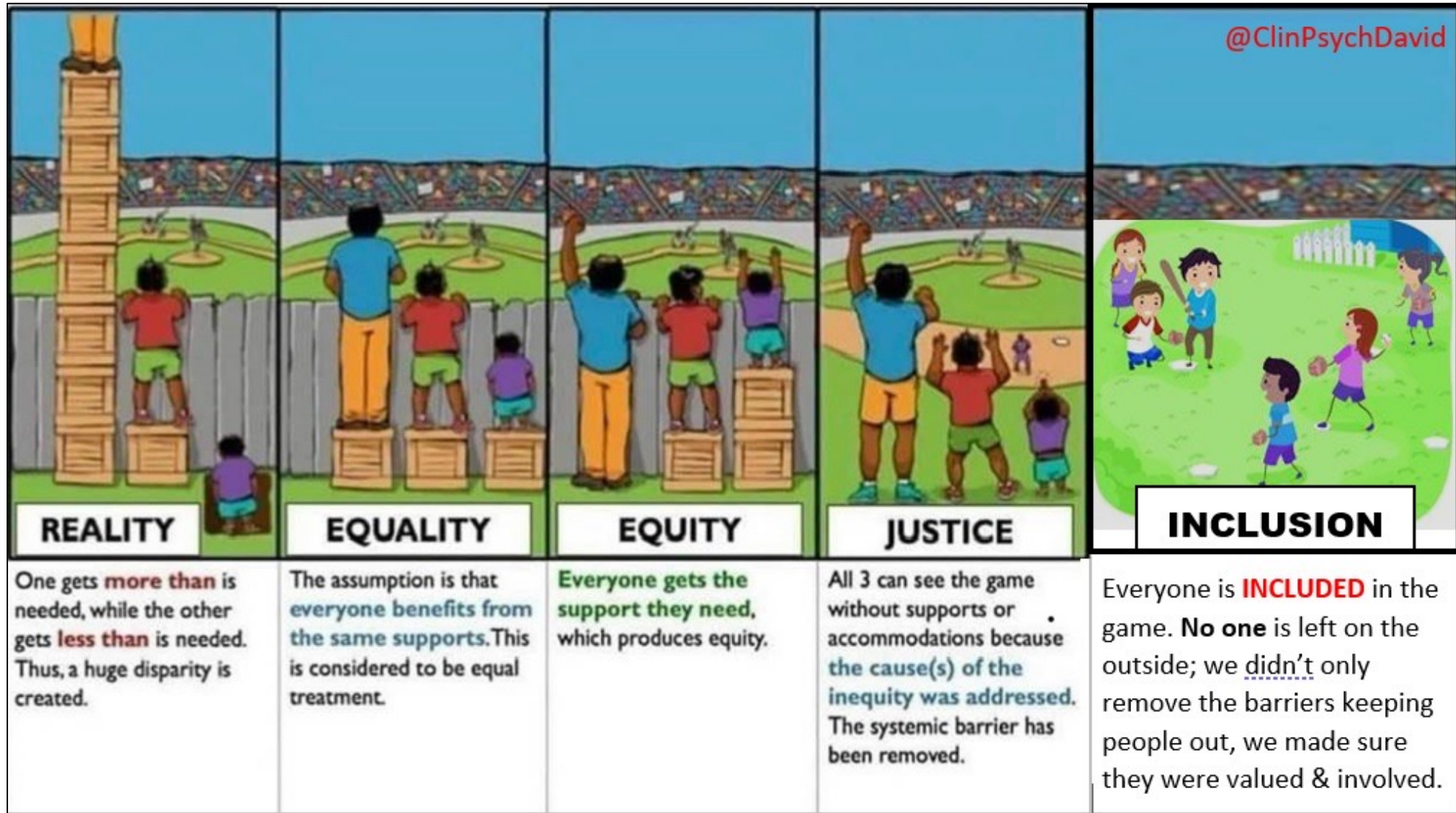
# STEM Careers and the Changing Skill Requirements of Work

---

David J. Deming & Kadeem L. Noray

“... skill demands in STEM occupations have changed especially quickly. The faster rate of change in STEM is driven both by more rapid obsolescence of old skills and by faster adoption of new skills.”

# These gaps multiply and perpetuate



How many of you have taken a workshop?



# Null effects of boot camps and short-format training for PhD students in life sciences

David F. Feldon<sup>a,1</sup>, Soojeong Jeong<sup>a</sup>, James Peugh<sup>b</sup>, Josipa Roksa<sup>c,d</sup>, Cathy Maahs-Fladung<sup>a</sup>, Alok Shenoy<sup>a</sup>, and Michael Oliva<sup>a</sup>

<sup>a</sup>Department of Instructional Technology & Learning Sciences, Utah State University, Logan, UT 84322-2830; <sup>b</sup>Department of Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45229-3026; <sup>c</sup>Department of Sociology, University of Virginia, Charlottesville, VA 22904; and <sup>d</sup>Curry School of Education, University of Virginia, Charlottesville, VA 22904

Edited by Dale Purves, Duke University, Durham, NC, and approved July 28, 2017 (received for review April 6, 2017)

# A minimal set of principles for effective, inclusive, and career-spanning learning



Learning after your undergraduate degree  
is different...





# Formal learning milestones

- Completing an undergraduate degree
- Completing a graduate degree
- Completing a post-doc
- Completing an industry internship

# Professional learning milestones

- Feeling intimidated by a talk/paper/blog



# Professional learning milestones

- Feeling intimidated by a talk/paper/blog
- Signing up for online courses/tutorials



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- Hiring someone who can do the work



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- Planning a sabbatical for next year

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- Bookmarking Stack Overflow

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- Bookmarking Stack Overflow
- Low-key stalking a developer on their social media

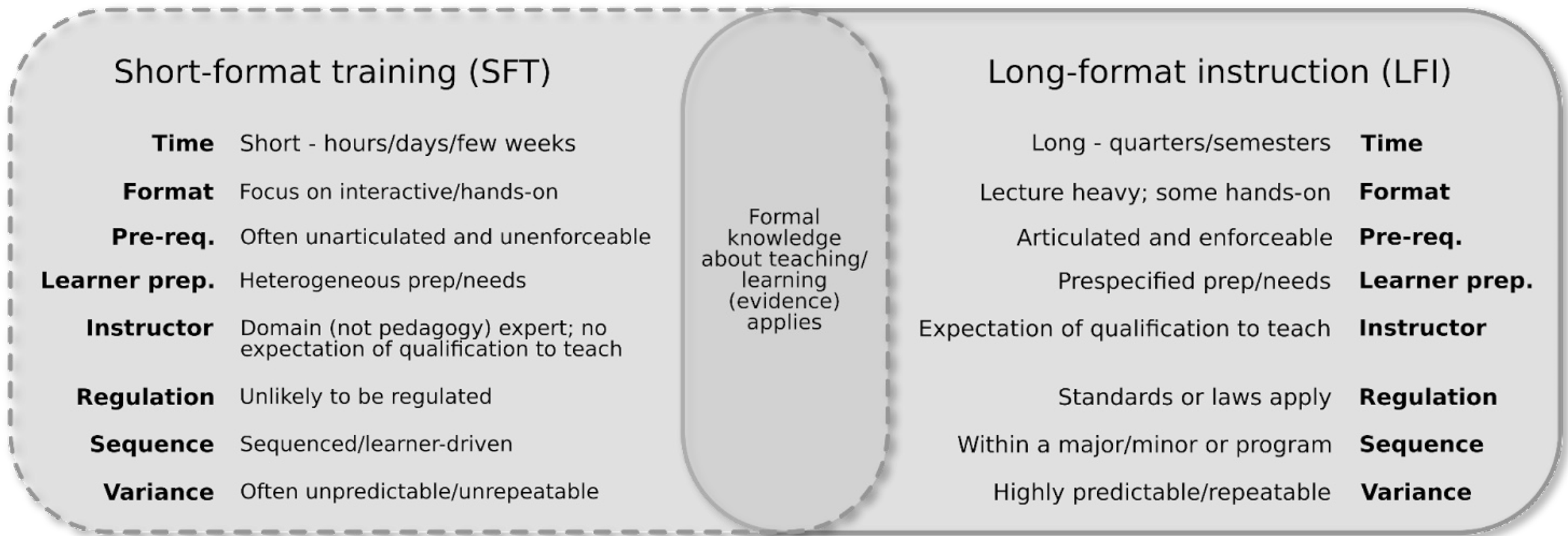
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- Applying what you have learn in a course/course



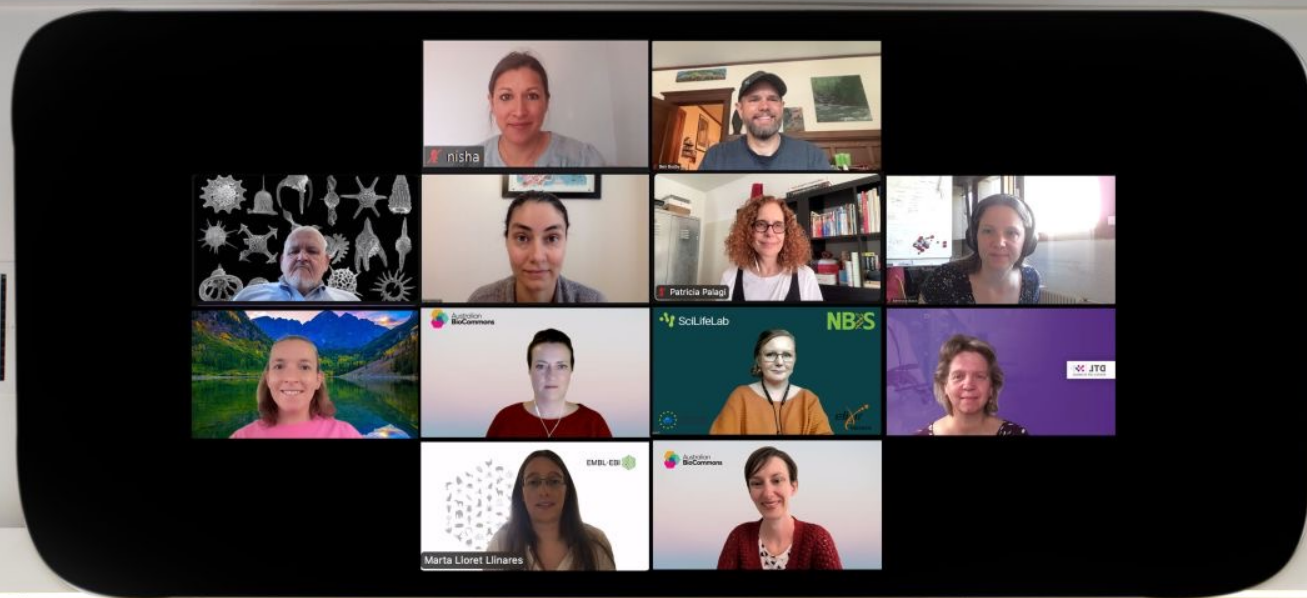
# Professional learning milestones

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- Applying what you have learn in a course/course



*Long-format courses that include multiple short modules, as well as continuing professional development (towards certification) and vocational training tend to fall outside the general characteristics shown.*

Figure credit: Bérénice Batut





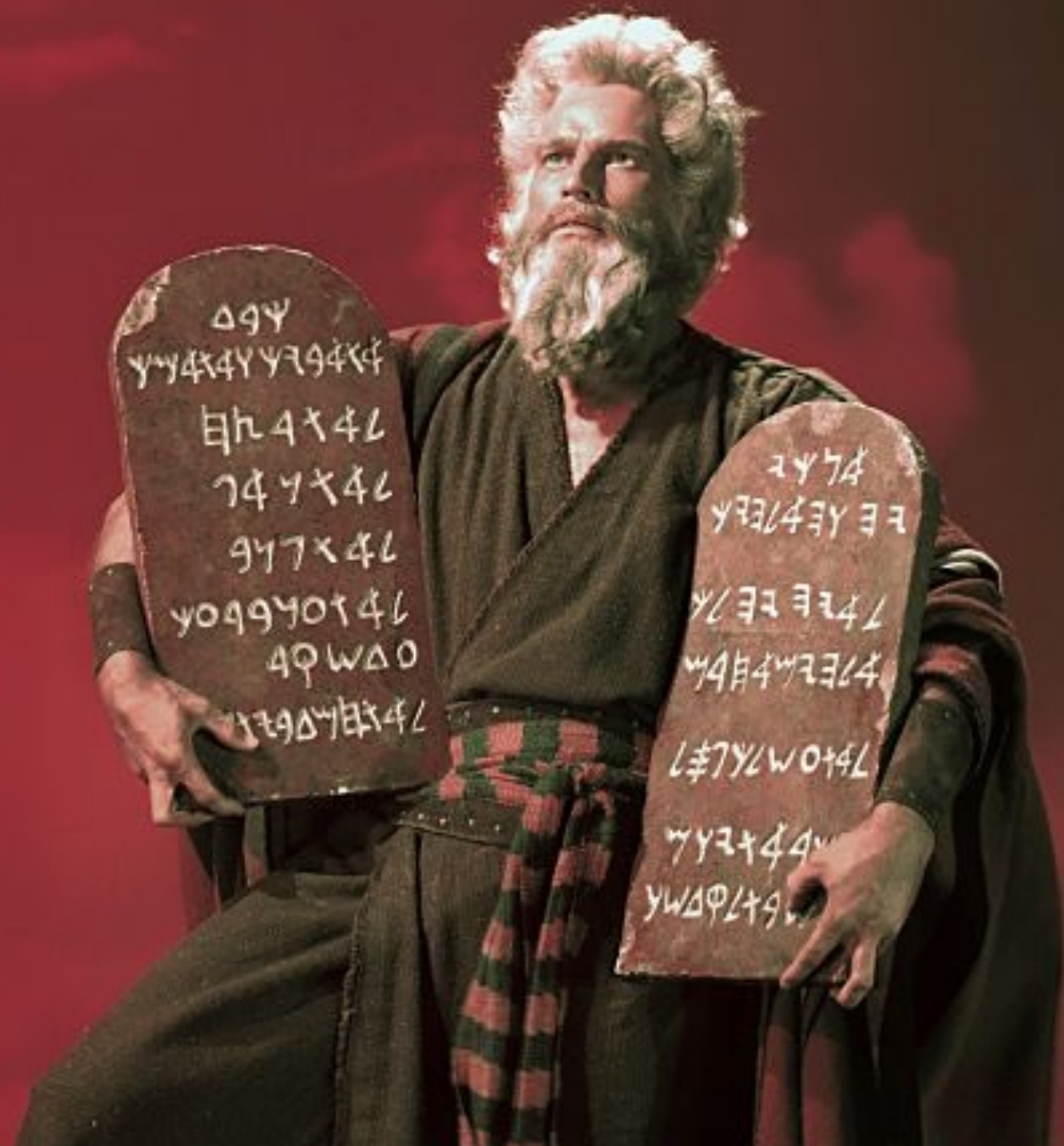
<b>Participant</b>	<b>Institution/Organization</b>
Bérénice Batut*	University of Freiburg
Erin Becker	The Carpentries
Anne Brown	Virginia Tech
Melissa Burke	Australian BioCommons/ QCIF and RCC at the University of Queensland
Ben Busby	DNAnexus
April Clyburne-Sherin	Reproducibility for Everyone
Nisha Cooch	CureComms Advisors, LLC
Allissa Dillman	Office of Data Science Strategy, National Institutes of Health (NIH)
Sam Donovan*	BioQUEST Curriculum Consortium
Maria Doyle	Peter MacCallum Cancer Centre
Jessica Guo	University of Arizona
Christina Hall	Australian BioCommons, The University of Melbourne
Kate Hertweck	Chan Zuckerberg Initiative
Kari Jordan*	The Carpentries
John R. Jungck	University of Delaware
Charla Lambert*	Cold Spring Harbor Laboratory
Ainsley Latour	IDEA-STEM





Jessica Lindvall	ELIXIR-SE
Marta Lloret Llinares	European Molecular Biology Laboratory - European Bioinformatics Institute
Gary McDowell	Lightoller LLC
Rana Morris	National Center for Biotechnology Information, NLM, NIH
Teresa Mourad*	Ecological Society of America
Amy Nisselle	Melbourne Genomics Health Alliance; The University of Melbourne
Patricia Ordóñez	University of Puerto Rico, Río Piedras
Lisanna Paladin	The European Molecular Biology Laboratory (EMBL) Heidelberg
Patricia Palagi	SIB Swiss Institute of Bioinformatics
Mahadeo Sukhai	Canadian National Institute for the Blind
Tracy Teal*	RStudio
Rochelle Tractenberg**	Georgetown University
Celia van Gelder*	Dutch Techcentre for Life Sciences
Jason Williams**	Cold Spring Harbor Laboratory DNA Learning Center
Lou Woodley	Center for Scientific Collaboration and Community Engagement (CSCCE)

\* Organizing Committee | \*\* Project Investigators



Δ9Ψ  
ΥΥ4X4YΥ794X4  
ΕΗ4X4L  
74ΥX4L  
9Υ7X4L  
Υ099Υ014L  
4ΦWΔ0  
179ΔΥΕX4L

2Ψ74  
Υ73L43Y33  
ΥL33334L  
Υ4E4E4  
L7Y7W014L  
ΥΥ2144  
ΥWΔΦL49L

# The Principles

- Label and capture the best of what many (but not all) do

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- Provide a path for individuals or groups to develop a predictable experience



# The Principles

- Label and capture the best of what many (but not all) do
- Provide a path for individuals or groups to develop a predictable experience
- Enshrine values and practices which may get lost due to scarce resources (time, experience, awareness)

# Core Principles

**All short-format training should...**

1. Use **Best Evidence**; grounded in findings from the education sciences and formally evaluated instruction.

# Core Principles

All short-format training should...

2. Promote **Catalytic** learning; prepare learners to succeed when the application of knowledge, skills, and abilities requires further self-directed study.

# Core Principles

All short-format training should...

3. Be **Effective**; provide evidence (i.e., from assessment, evaluation) to learners that they have made progress in achieving programmatic and learning goals.



# Core Principles

All short-format training should...

4. Be **Inclusive**; maximize the ability of all learners to participate in and benefit from the learning experience.

# Community Principles

**Communities increase the impact of short-format by working to ...**

**5. Reach:** include new types and larger audiences of learners.

# Community Principles

**Communities increase the impact of short-format by working to ...**

**6. Scale:** increase delivery of short-format training by new groups and larger numbers of instructors and instructional developers.

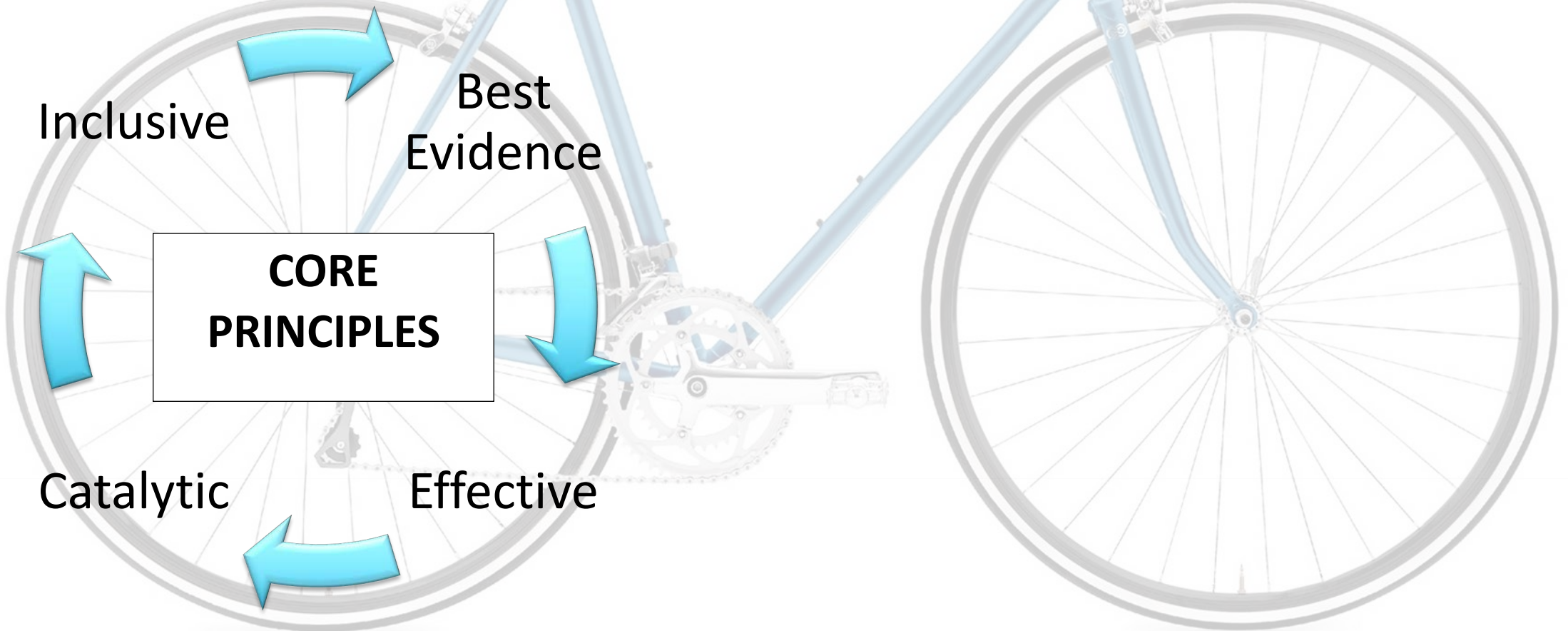
# Community Principles

**Communities increase the impact of short-format by working to ...**

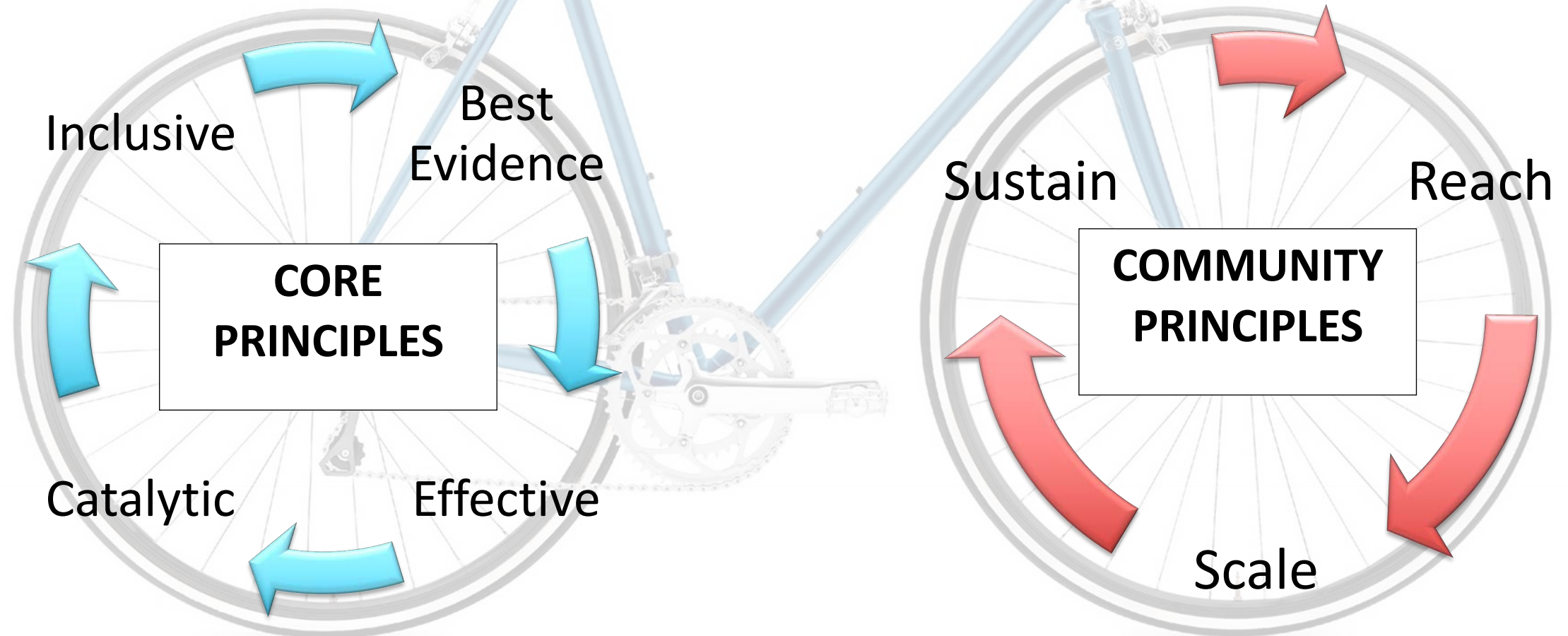
**7. Sustain:** work to maintain the availability, usability, relevance, and reliability of learning materials as well as supporting the supporting infrastructures, trainers, and communities which enable effective and inclusive training.



# “The unicycle” – fine for going alone



# “The bicycle” – good for going far



The Bicycle Principles  
v1.0.3 - October 2022

GitHub

Home

- The need for a community-driven principle-based framework
- The Bicycle Principles for short-format training
- The Principles and this website
- Banbury Working Group
- Citations and publications
- Funding

► Recommendations and Surveys

Glossary and Definitions

Community Feedback and Next Steps

Introduction to the Recommenda... Next >

# The Bicycle Principles for Effective, Inclusive, and Career-spanning Short-format Training

*Improving Professional Development in the Life Sciences and Beyond*

**Announcement**  
**November 2022**

**We're collecting feedback:** Let us know what you think about the recommendations to improve short-format training. We will be conducting surveys and focus groups from now through February 2023. **Participants will be compensated for their time.**



**bikeprinciples.org**



This material is based upon work supported by the National Science Foundation under [DRL/EHR:2027025](https://www.nsf.gov/awardsearch/showAward?AWD_ID=2027025).

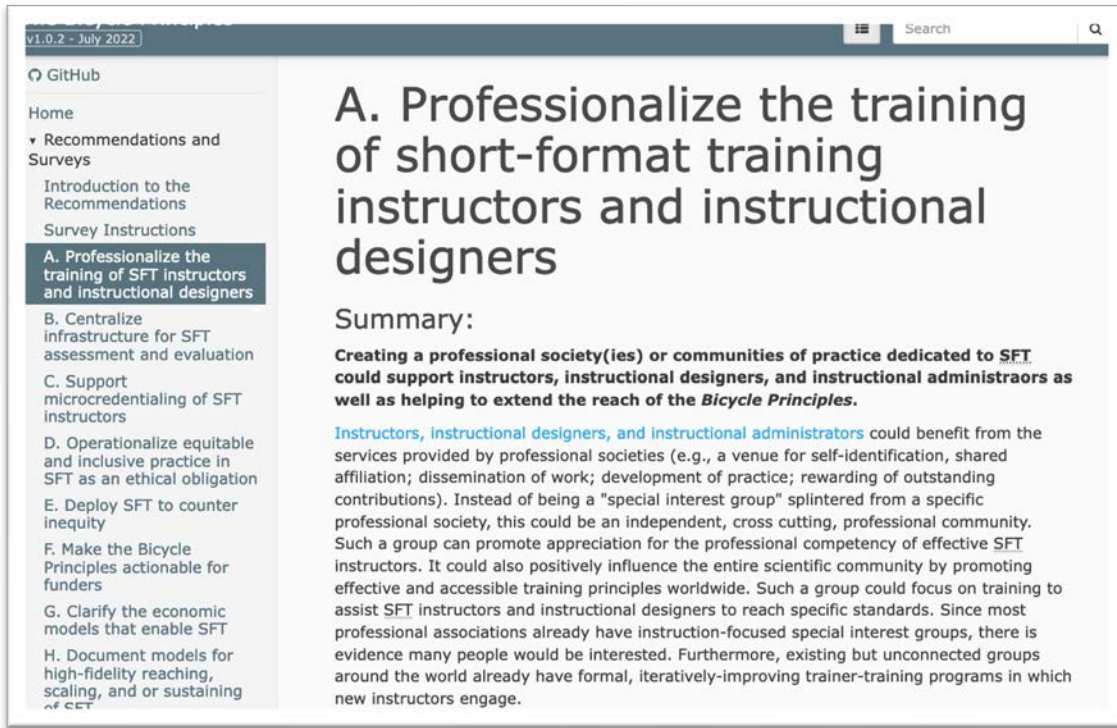


Cold Spring Harbor Laboratory

# Example recommendations







- Summary:** Expands upon what problem the recommendation tries to solve.
- How might this work:** Brief implementation example and suggestions on evaluating success.
- Related Principles:** Most closely related *Bicycle principles*.
- Benefits to the learners:** How recommendation helps learners (directly or indirectly).
- Incentives to Implementers:** Motivations for implementers to enact this recommendation.
- Barriers to Implementation:** Obstacles that may hinder this recommendation.

## Survey question

After reading the [survey instructions and consent page](#) and the recommendation above please rate and leave feedback using the survey questions below:

### **Bicycle Principles - Recommendation J: Encourage interoperable short-format training registries**

\* 1. Which of the following roles best describes how you'll give feedback on this recommendation?

- ☐ As a learner (someone who mostly attends short-format training)
- ☐ As an SFT instructor (someone who mostly teaches short-format training)
- ☐ As an SFT instruction designer (someone who mostly designs short-format training curriculum)
- ☐ As an SFT instructional administrator (someone who mostly hosts and organizes short-format training)

0 of 2 answered

powered by  SurveyMonkey

Create your own user feedback survey

# What stakeholder are you?

## How do you rate:

- Benefits to learners
- Incentives to implementors
- Barriers to implementation
- Your likelihood to implement



# **D. Operationalize equitable and inclusive practice in short- format training as an ethical obligation**



Large crowd of people having fun

# E. Deploy short-format training to counter inequity



Judge in robe fighting for justice



# K. Communicate standards of instruction through badging



Scout earning a badge

# A. Professionalize the training of short-format training instructors and instructional designers



Doctor studying a textbook

# How could we “professionalize” Training?



# Professionalizing training

- Create avenues for self-identification, shared affiliation; dissemination of work; development of practice; rewarding of outstanding contributions





# Professionalizing training

- Create avenues for self-identification, shared affiliation; dissemination of work; development of practice; rewarding of outstanding contributions
- Instead of being a "special interest group" splintered from a specific professional society, this could be an independent, cross cutting, professional community.

# Professionalizing training

- Create avenues for self-identification, shared affiliation; dissemination of work; development of practice; rewarding of outstanding contributions
- Instead of being a "special interest group" splintered from a specific professional society, this could be an independent, cross cutting, professional community.
- As a community of practice, the society could:
  - I) vet, curate, and/or maintain centralized resources
  - II) work to clarify and address significant challenges
  - III) share innovations for the delivery of effective, inclusive, and career-spanning SFT



# Incentives

## For Instructors

- Recognition of their role and its importance in the scientific community, peer support, and increased sense of community.



# Incentives

## **For Instructors**

- Recognition of their role and its importance in the scientific community, peer support, and increased sense of community.

## **For Instructors, Instructional Designers, Instructional Supporters**

- Collective impact could help disseminate effective practices and enhance adoption of practices that individual instructors or SFT programs might have difficulty implementing alone.
- Opportunities to develop new, better, and sustainable, economic models for SFT as well as models for applying community *Bicycle Principles* (i.e., *Reach, Scale, Sustain*).





# Incentives

## **For Instructors**

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## **For Funders and Organizations**

- Working with an SFT professional society may strengthen justifications for SFT funding and allow funders to interact with multiple programs through a single group.



Change requires more than sharing ideas.  
We must build communities and support them.

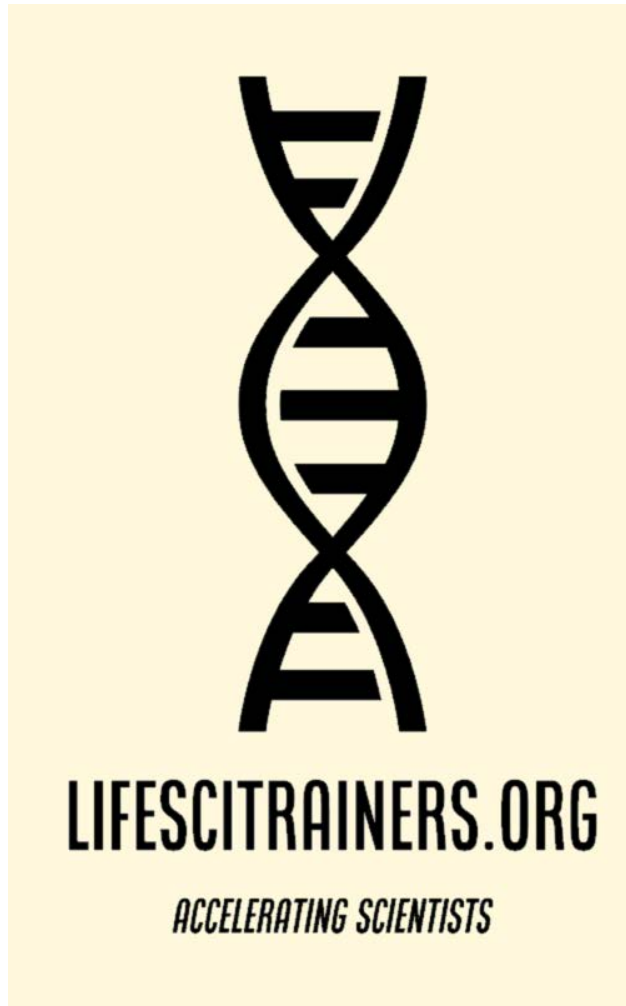


# What is a community of practice?

“Communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly.” - Etienne and Beverly Wenger-Trayner



# Building community



## Why short-format training?

In many areas of the life sciences new technologies and approaches (especially, but not only computational ones) are changing rapidly. It's not possible for formal training (undergraduate/graduate) to keep pace, but short-format training can fill these gaps. Short-format training comes with its own set of challenges, and this community works together to address them.



### How I Teach Life Scientists...by Using Reproducible and Scalable Learning Environments

May 12, 2022 /// No Comments

The combination of Docker + cloud computing service enables a teacher to create a highly scalable and flexible learning environment

[Continue reading »](#)



### How I Teach Life Scientists...to Build Reproducible, Scalable Workflows with Nextflow

April 20, 2022 /// No Comments

The term "reproducible research" has been used to describe the idea that a scientific publication should be distributed along with all the raw data and metadata used in the study, all the code and/or computational notebooks needed to produce results...

[Continue reading »](#)



### March 2022: Community Discussion – The Return to In-Person Training

March 14, 2022 /// No Comments

Many instructors have or shortly will be running their first in-person events since the pandemic, what will change?

[Continue reading »](#)

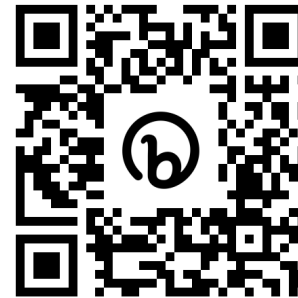


community = sustainability





*“The illiterate of the 21<sup>st</sup>  
century will not be those  
who cannot read and write,  
but those who cannot  
learn, unlearn, and relearn”*  
– A. Toffler



**Thanks!**



This material is based upon work supported by the National Science Foundation under [DRL/EHR:2027025](https://www.nsf.gov/awardsearch/showAward.do?awardNumber=DRL/EHR:2027025). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.