

Disclaimer: This presentation does not reflect the views of Michigan State University (my employer), the Union of Tenure System Faculty, the Michigan Education Agency, or any other organization with which I am affiliated.

we are at risk of losing a generation of scientists. what can we do?

aot lansing - 18 june 2025

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Department of Computational Mathematics,
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CREATE For STEM Institute*

University of Oslo

*Department of Physics
Centre for Computing in Science Education*

What do I do with my science degree?

a few things...

- BS in Physics from Texas; MS & PhD in Physics from Georgia Tech; Postdoc Physics Education at CU-Boulder
- Copy shop manager; Kinko's (later, Fedex)
- High school physics teacher; Atlanta Public Schools
- Professor of Physics and Computational Science at MSU and UiO
- Co-direct two research labs at MSU (in Physics & Computational Science Education)
- Labor Organizer and Negotiator for Union of Tenure System Faculty-MEA



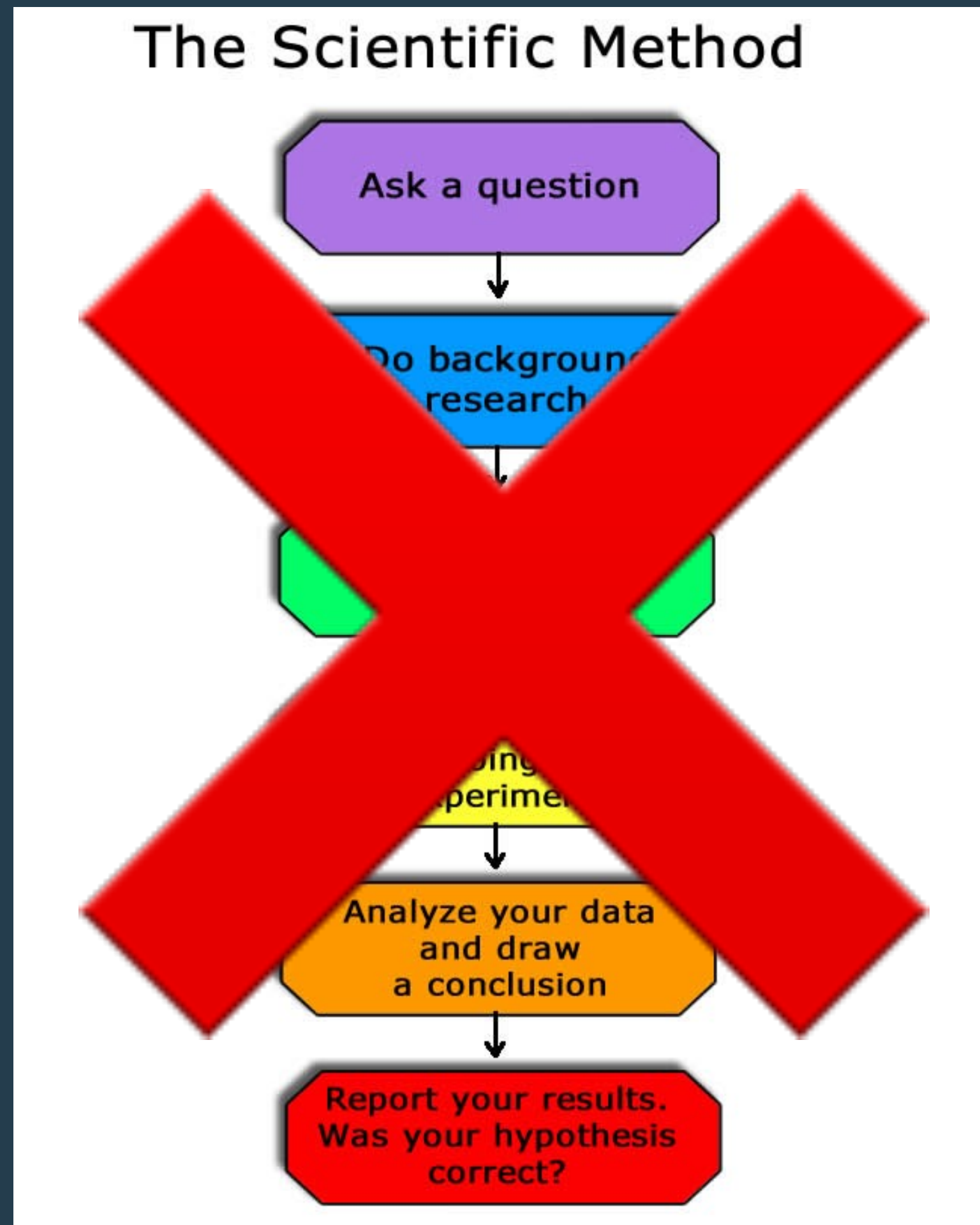
 Danny Caballero
github.com/dannycab

13 followers · 2 following
Michigan State University · East Lansing, MI
@physicstdanny

Since November 2011



What is science?



Science is a **messy, iterative, and nonlinear process** by which we develop **reproducible and predictable** understandings of the natural world.

- Science is grounded in history, theory, experiment, and application.
- Science can be independently validated and its biases can be interrogated.
- Science affects every person in and outside the U.S.





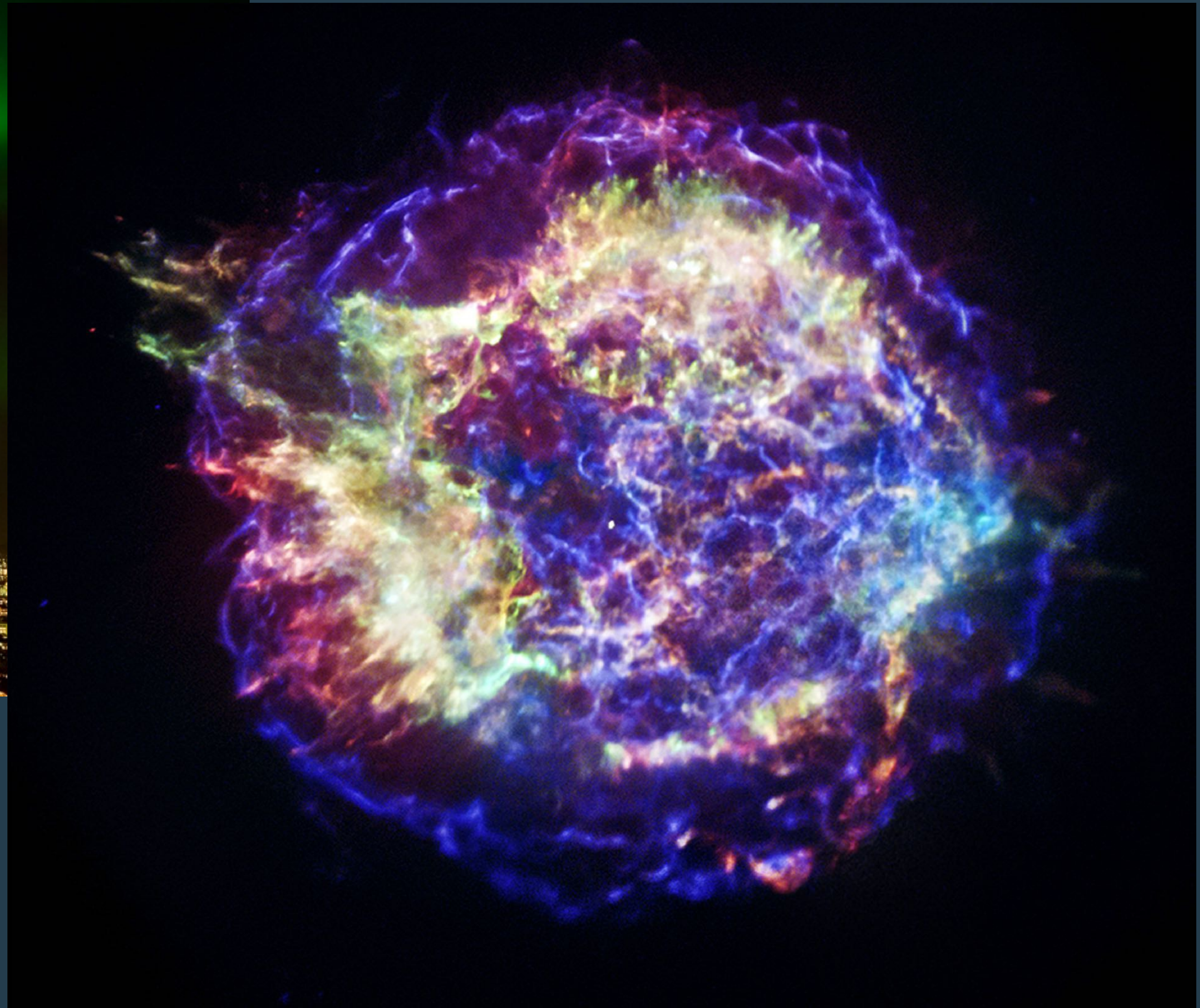
aurora borealis over oslo

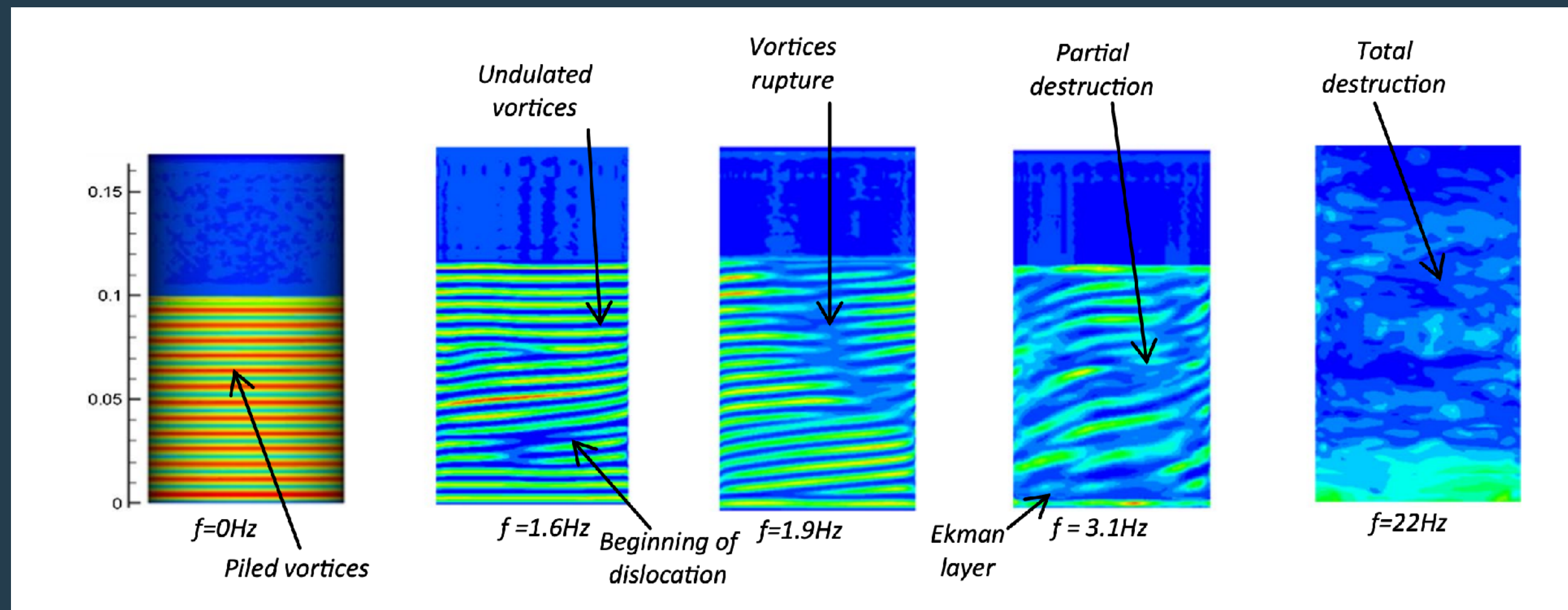
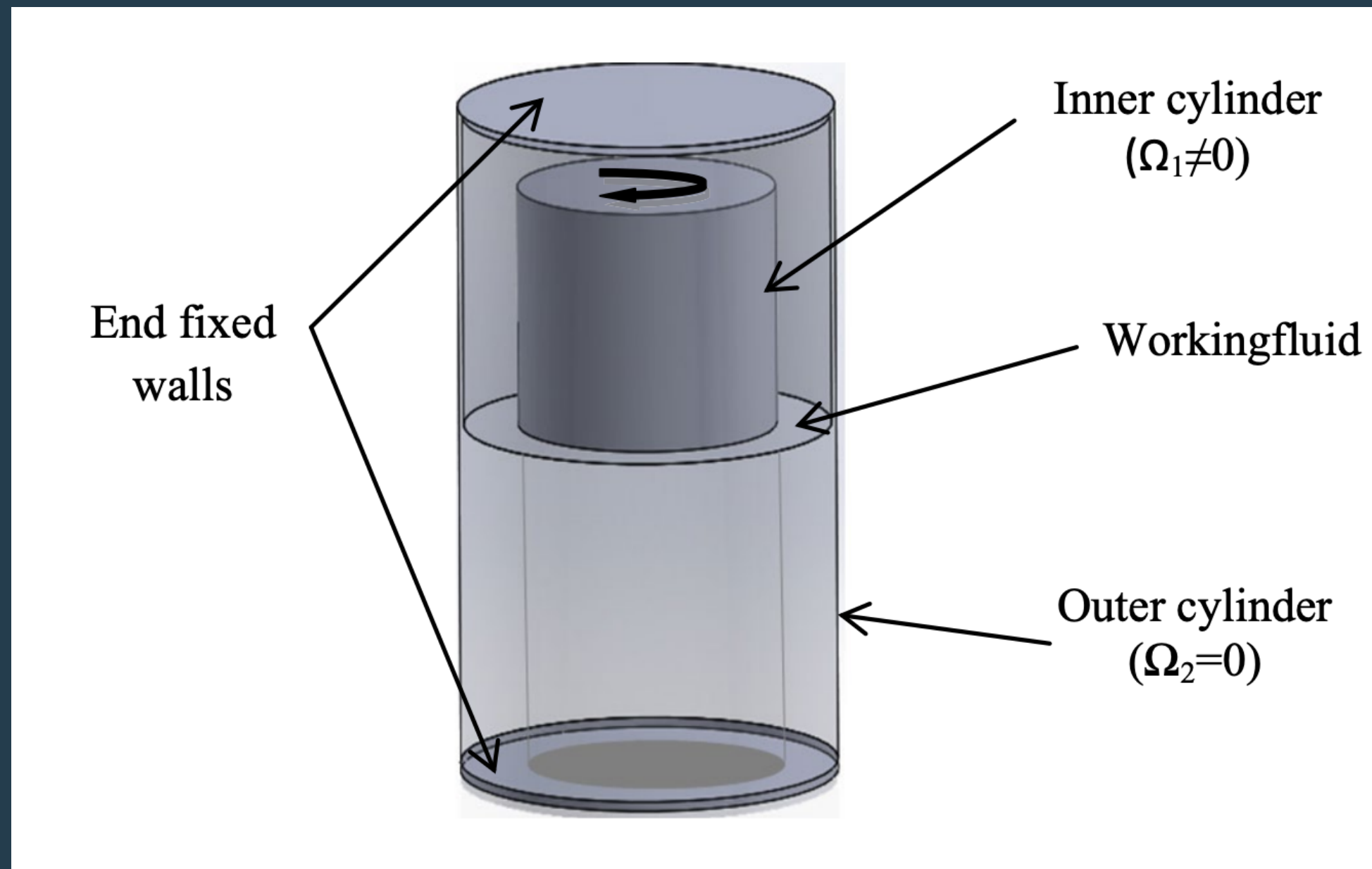
<https://www.flickr.com/photos/65218245@N00/326627830>

**science can explain
natural phenomena**

supernova remnant - cassiopeia a

https://www.nasa.gov/mission_pages/chandra/multimedia/exploring-cassiopeiaA.html





natural transition to turbulent flow

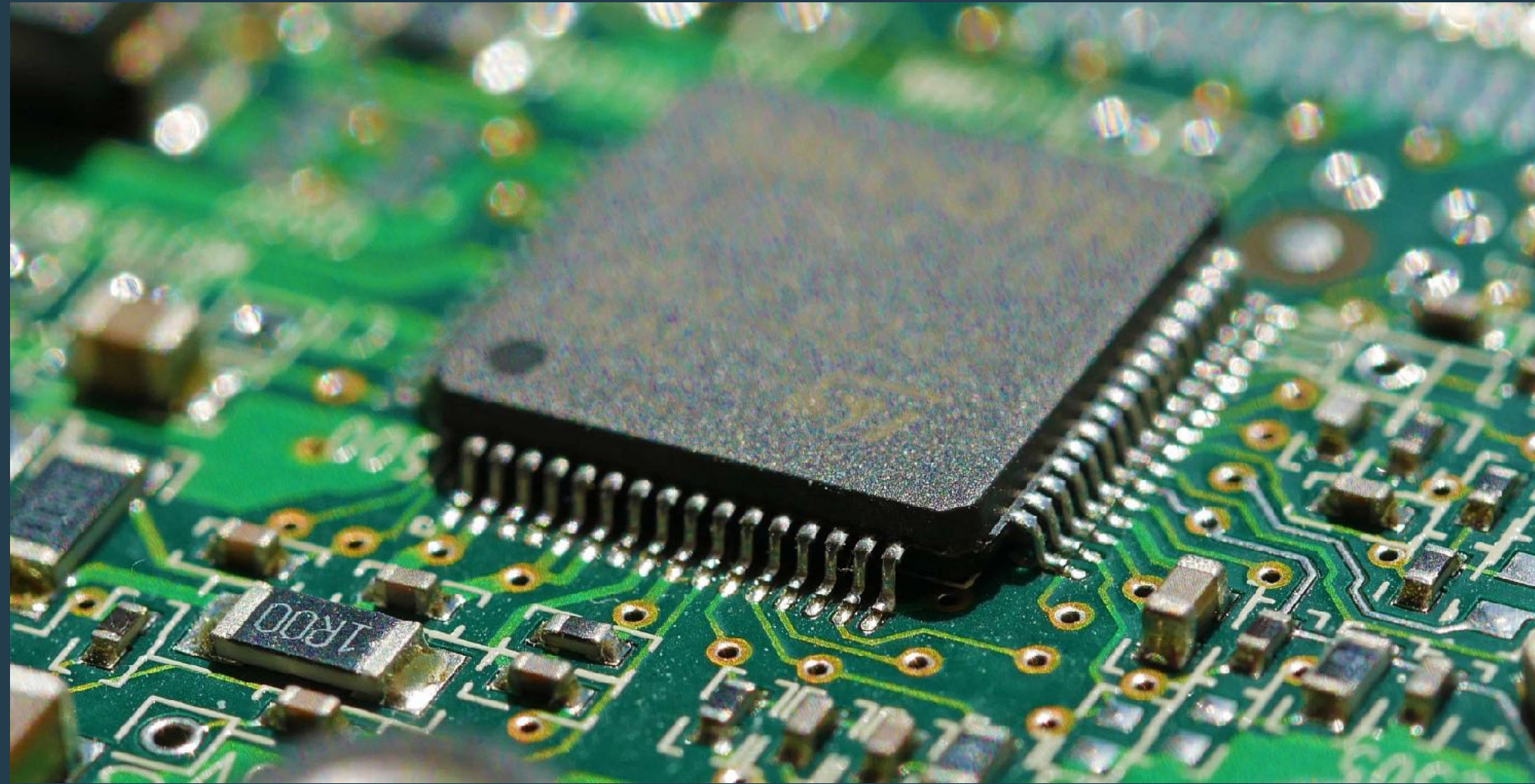
<https://www.flickr.com/photos/22493175%40N02/50000447596>

taylor-couette cylinder & transition to turbulence

Abdelali, A., et al. *Journal of the Brazilian Society of Mechanical Sciences and Engineering* 41.6 (2019): 259.

science can satisfy
human curiosity

science can benefit society



axioms

science is for everyone

science can be an immense public good

science must be representative of everyone

**talent is everywhere
opportunity isn't**

implications

everyone can develop a positive stance towards science

anyone can develop a deep understanding of science

anybody can shape the work and practice of science

our labs discover, design, and develop the
conditions and environments in which all folks
who are learning science can thrive



more folks learn
science better
greater diversity
across all of
science

a science that is more
representative of and
responsive to society

a society that deeply
values and strongly
supports science

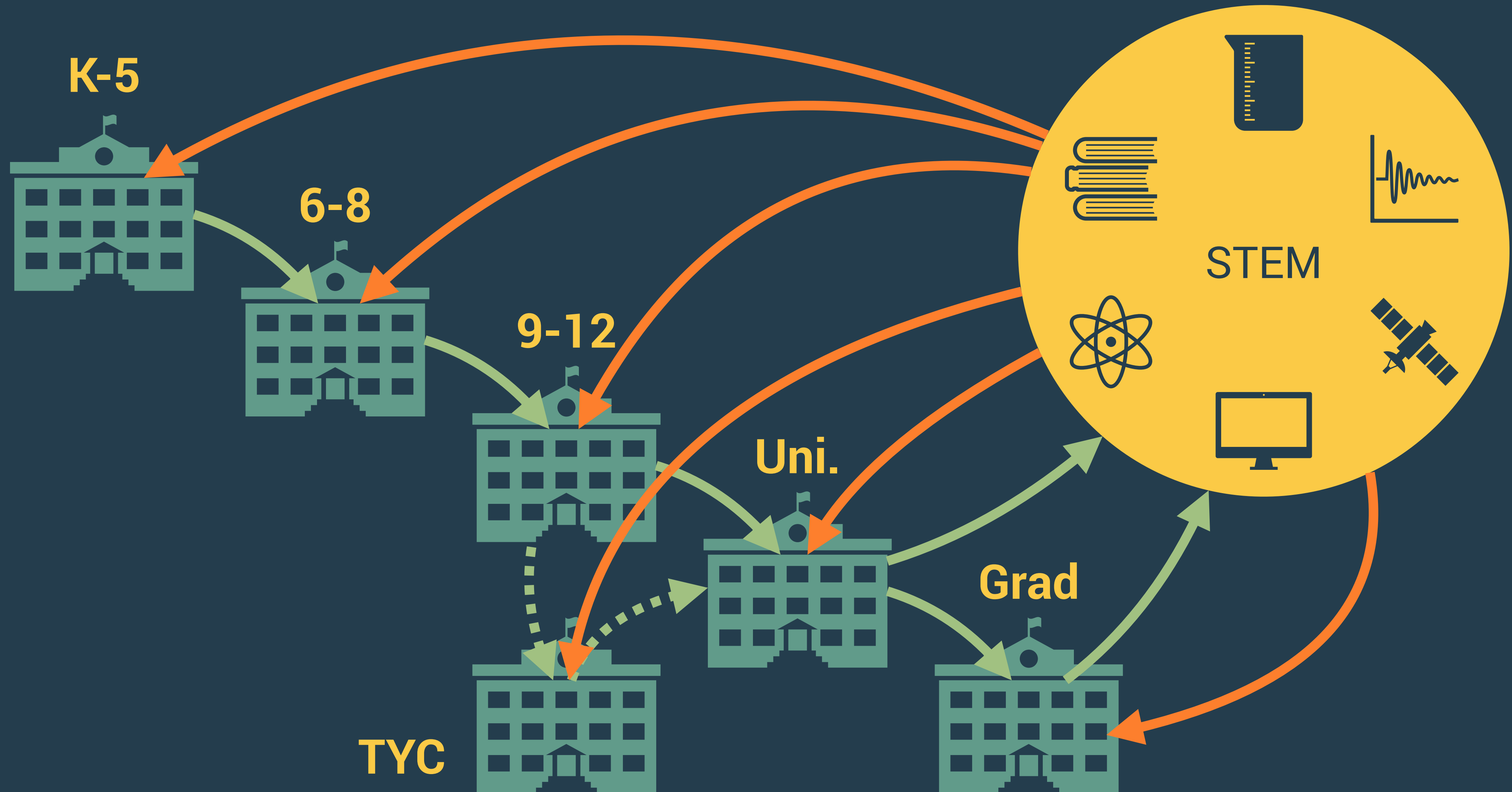
STEM in Michigan

- Many students in Michigan do not achieve proficiency in science and math.
- Advanced STEM courses are inaccessible to many students.
- Few high school graduates demonstrate college readiness.
- Few students who enroll in two-year colleges complete their degree programs.
- Students of color and those who are economically disadvantaged are disproportionately affected.
- Few women and students of color earn STEM degrees.

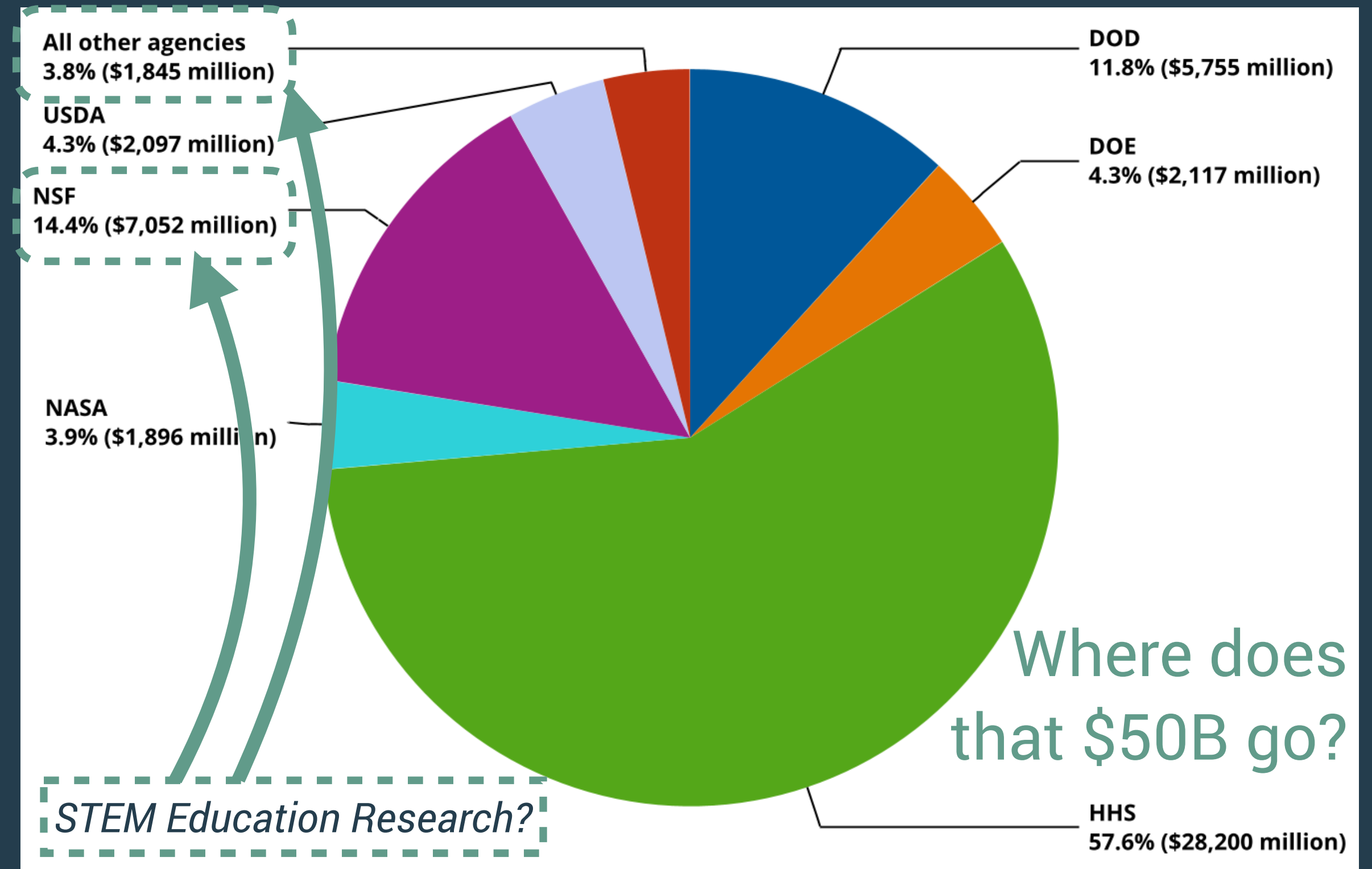
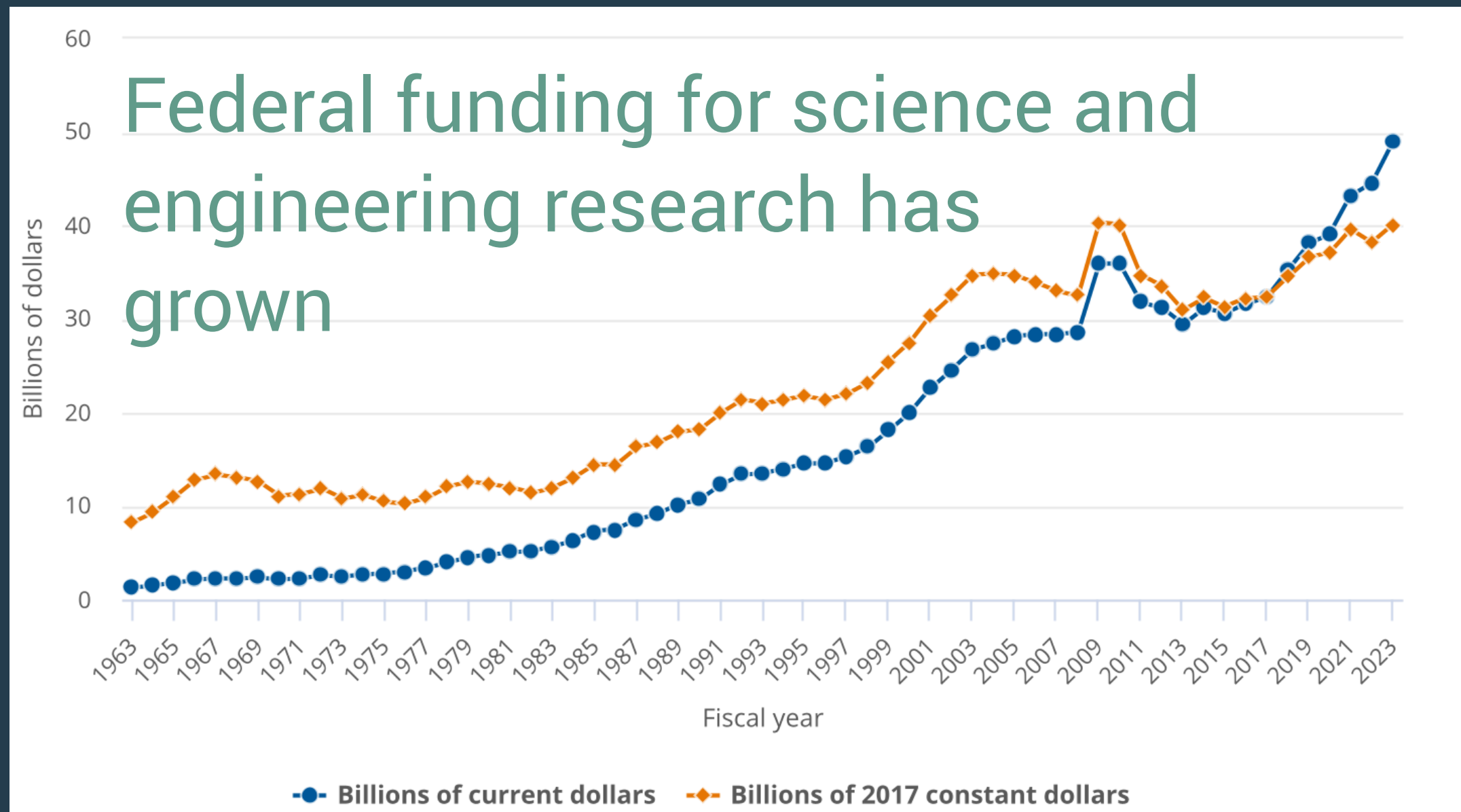


> 75% of MSU students are Michiganders.

our educational systems are interconnected not isolated



federal funding for research



Why federal funding?

It empowers broad participation in shaping science.

It expands opportunity and equity in science.

It builds the future—workforce, economy, safety, security, and resilience.

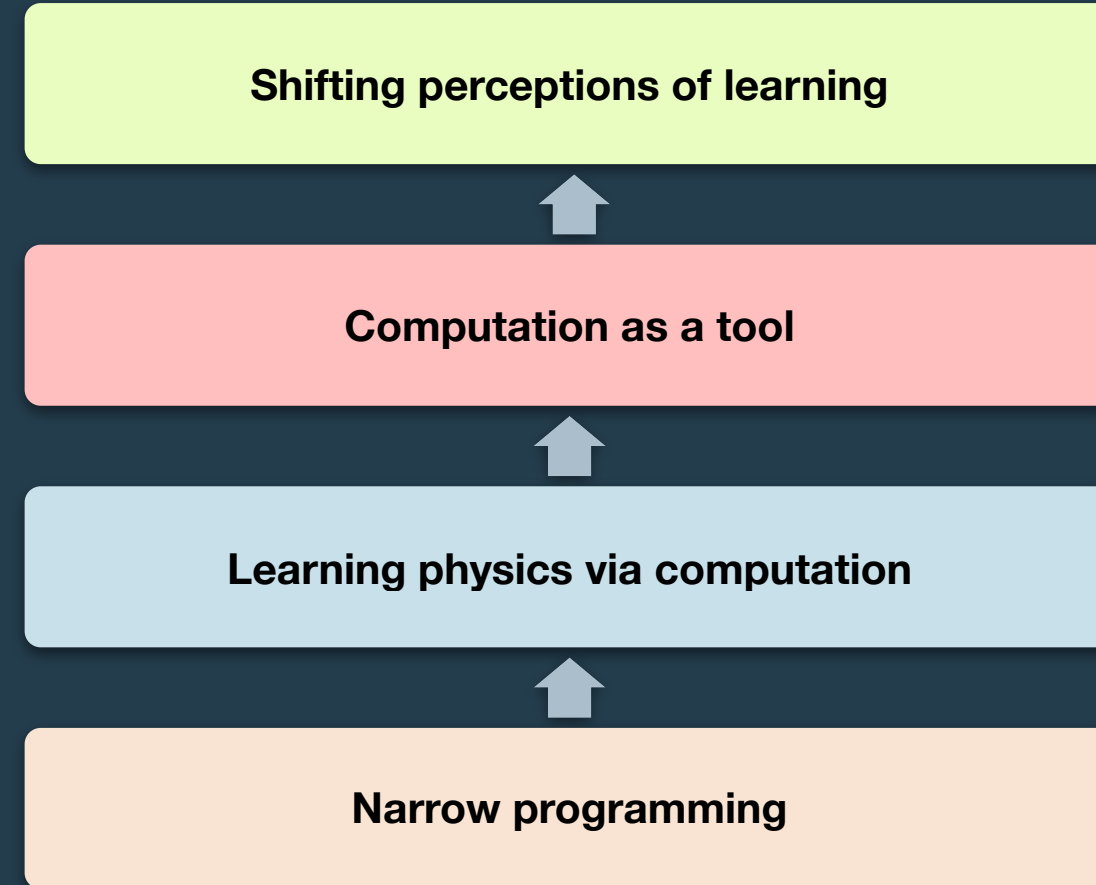
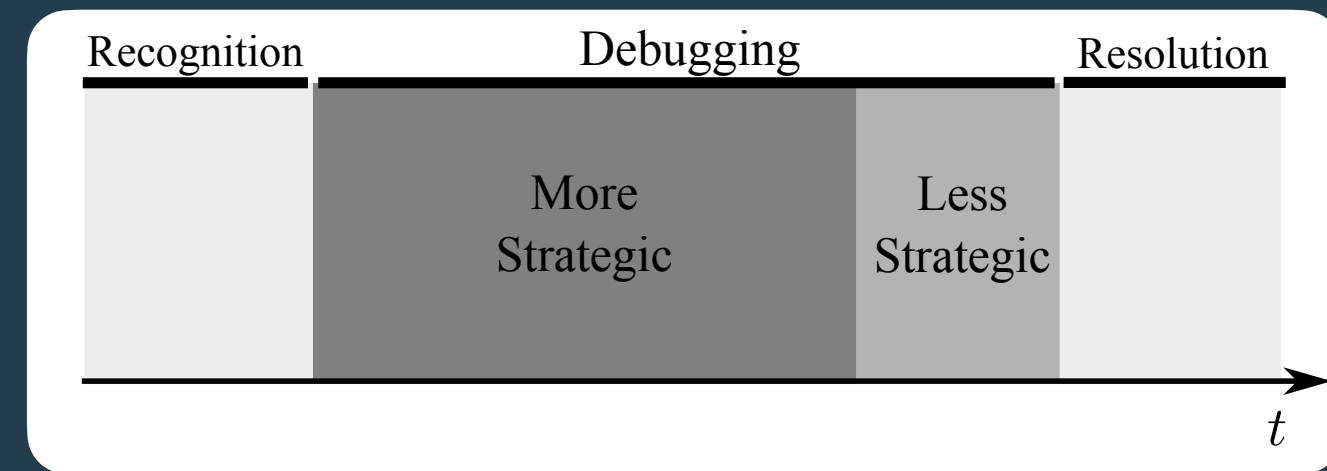
It ensures science is accountable and accessible to the American public.

Only public investment can support the scale and scope of innovation the nation needs.

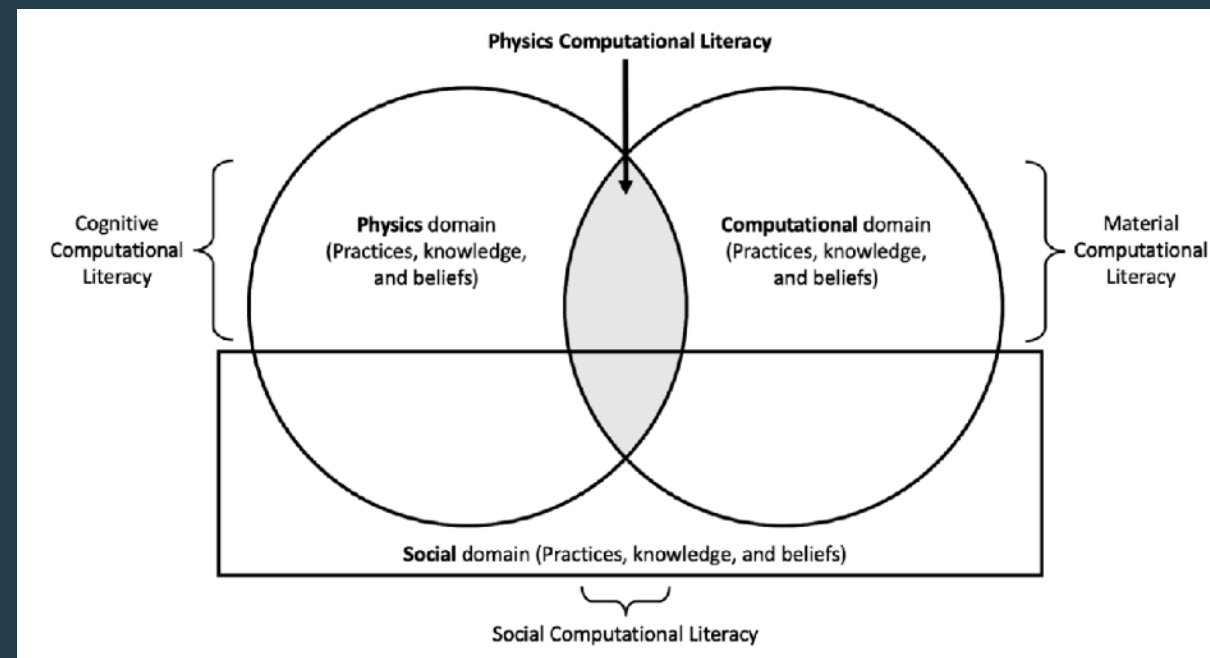
Science funded by the public must serve the public good.

integrating computing in physics

research



Obsniuk, Irving, Caballero, PERC 2015
 Pawlak, Irving, & Caballero, Phys. Rev. PER, 2020
 Odden, Lockwood, Caballero, Phys. Rev. PER, 2019



faculty learning community

Caballero, et al. TPT 57.6 (2019): 397-399.
 gopicup.org



community engagement

department-wide efforts

	F13	S14	F14	S15	F15	S16	F16	S17	F17	S18	F18	S19	F19	S20	F20	S21	F2X
Intro. Mech.																	
Intro. E&M																	
CMSE 201*																	
Modern Phys.																	
Class. Mech. 1																	
Quantum 1																	
Quantum 2																	
E&M 1																	
E&M 2																	
Stat. Mech.																	

Caballero & Hjorth-Jensen, 2018

supporting pre-college physics educators



Michigan K-12 Standards
Science



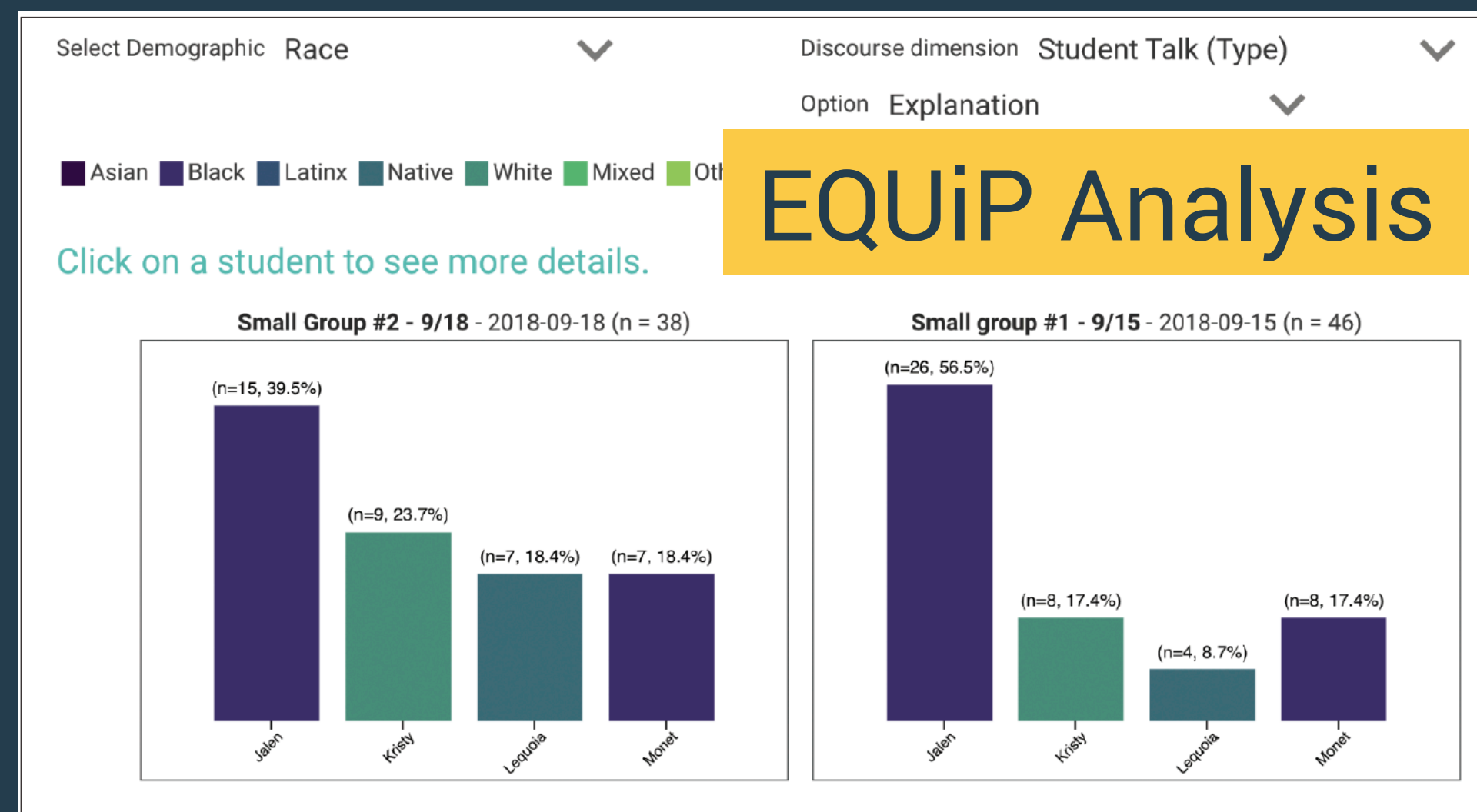
November 2015



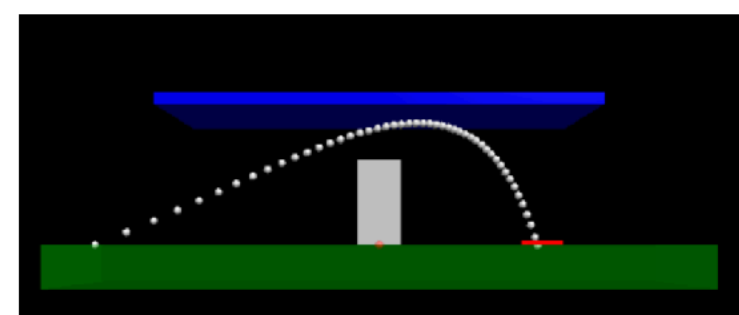
create a **computational model** to calculate...

use mathematical and/or **computational representations** to support explanations of factors...

use mathematical or **computational representations** to predict the motion...



Marshmallow Launch



Activity Information

Learning Goals

- Create and modify a computational model to describe a given system
- Use Newton's second law to relate the acceleration of a marshmallow with the forces acting on it ([HS-PS2-1](#))

<https://www.msuperl.org/wp/icsam/>

Weller, et al. *Phys Rev PER* 18.2 (2022): 020106.

teacher developed computing activities

Willison, et al. 2022 PERC Proc.
Stroupe, David, et al. ICLS 2022.

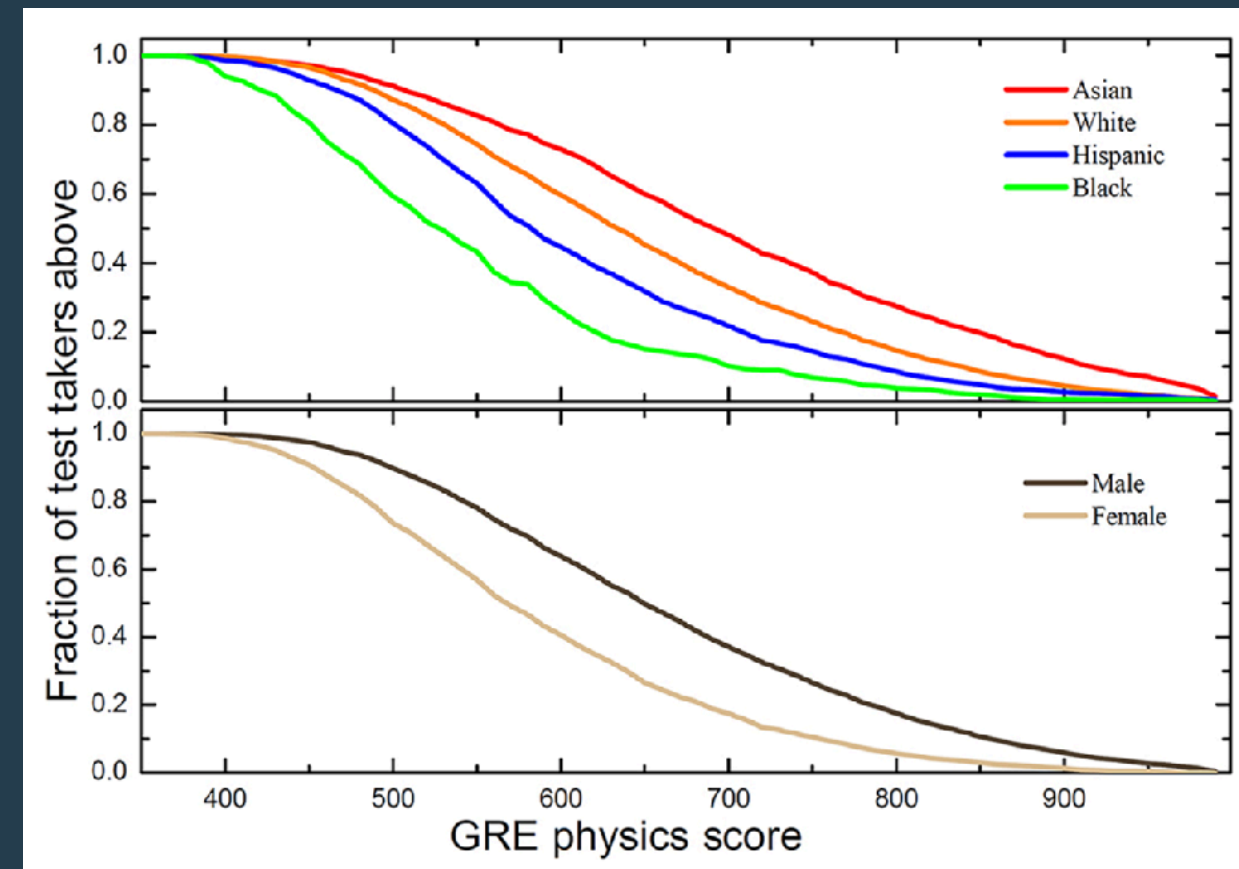
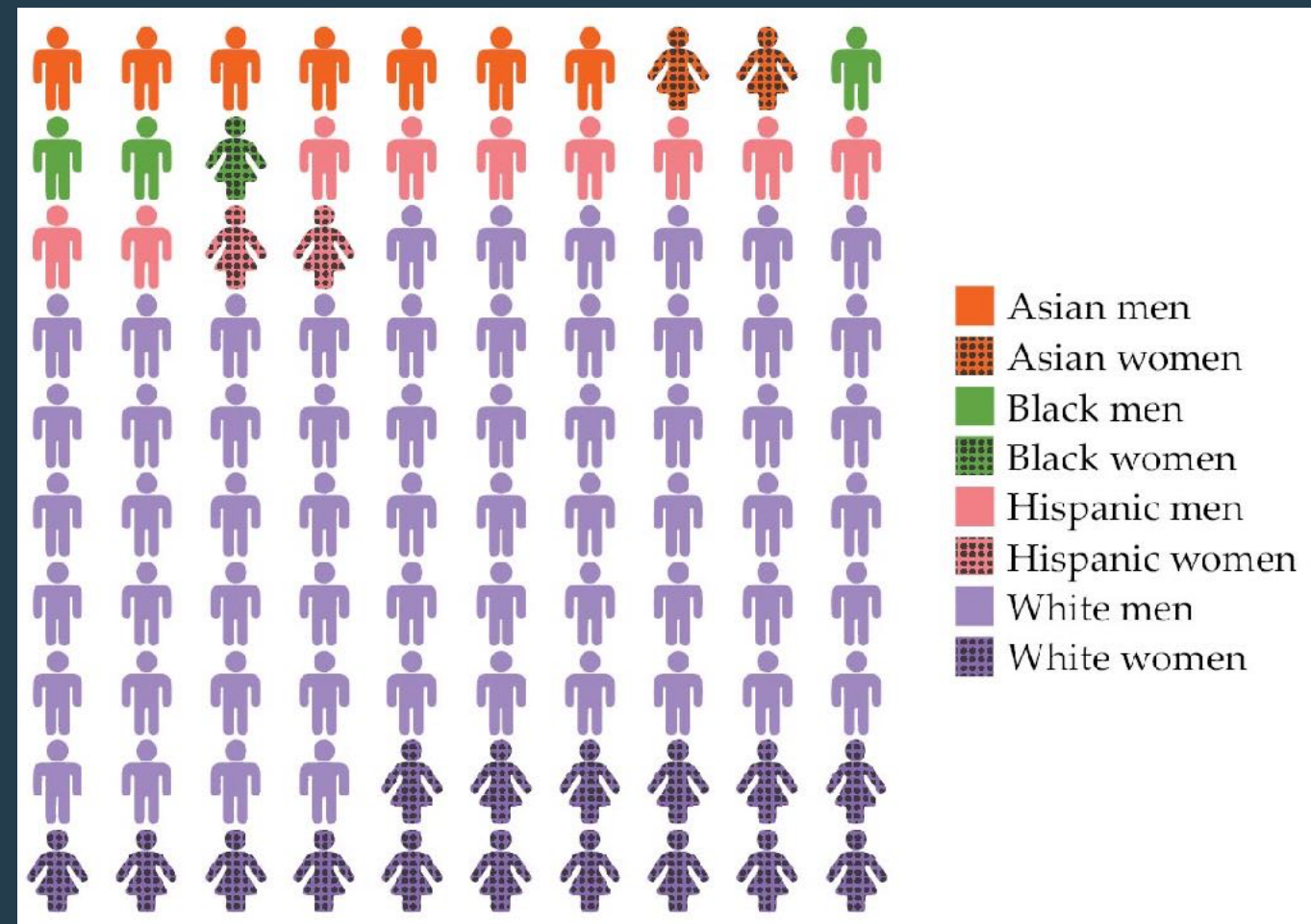
Hamerski, Patti C., et al. *Phys Rev PER* 18.2 (2022): 020109.

equip.ninja
Christensen, et. al. *TPT* 60.6 (2022): 414-418.

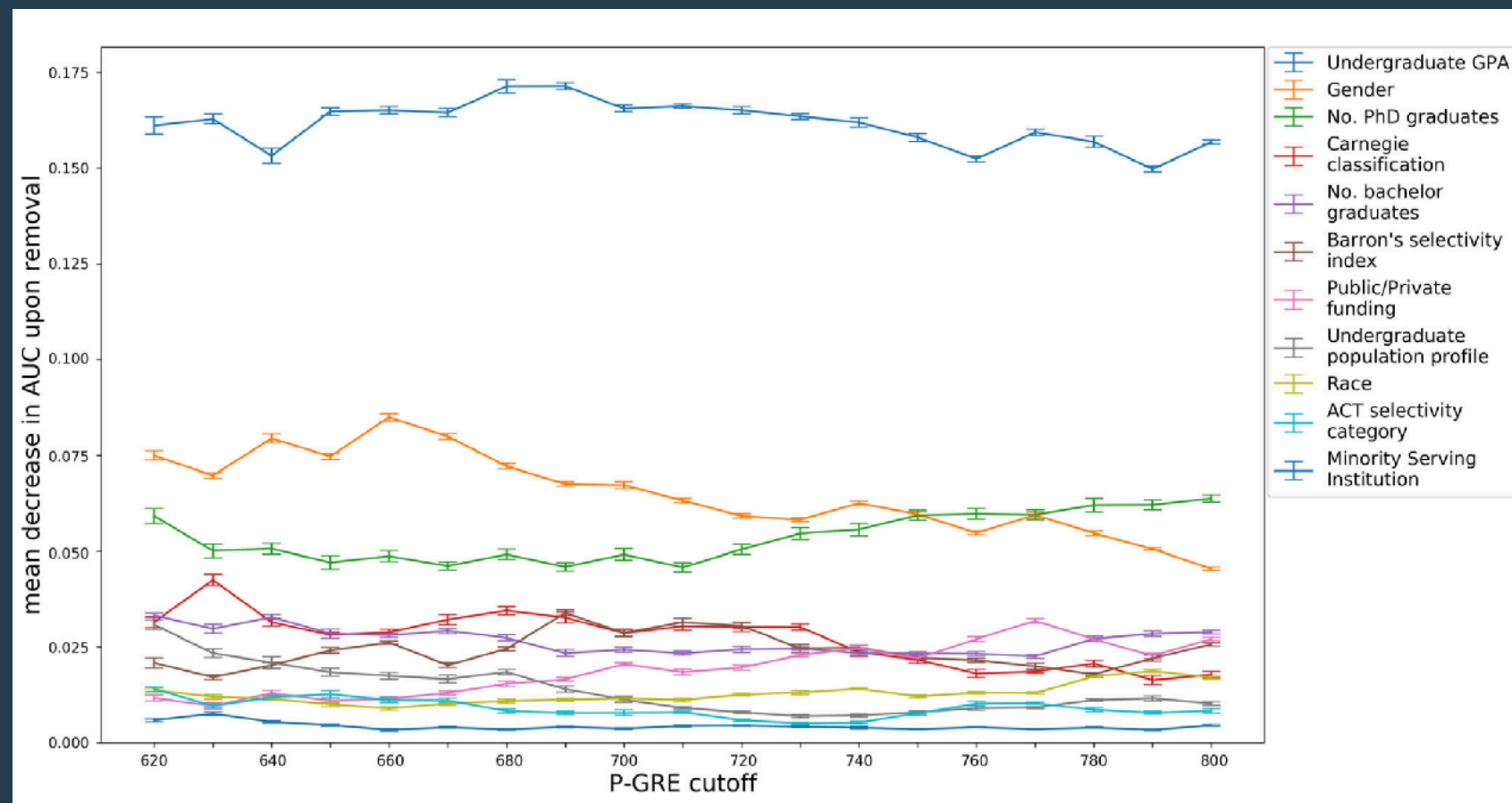


diversifying graduate physics programs

potential physics phd applicants



test is biased & not representative of grad programs



test cutoffs limit applicants

we now use a holistic rubric

Most common rubric score

	Low	Medium	High
ACADEMIC PREPARATION			
Physics coursework	✗		✓
Math coursework		✗	✓
All other coursework			✓ ✗
Academic honors	✗		✓
RESEARCH EXPERIENCE			
Variety/duration of research			✓ ✗
Quality of work		✗	✓
Technical skills		✗	✓
Research dispositions		✗	✓
NONCOGNITIVE COMPETENCIES			
Achievement orientation		✗	✓
Conscientiousness		✗	✓
Initiative		✗	✓
Perseverance		✗	✓
FIT WITH PROGRAM			
Alignment of research		✗	✓
Alignment with faculty		✗	✓
Community contributions		✗	✓
Diversity contributions	✗		✓
SCORES			
General GRE scores			✓ ✗
Physics GRE score	✗	✓	

✓ Admitted ✗ Nonadmitted

Young, Verboncoeur, Lam, and Caballero *Phys Rev PER* 19.1 (2023): 010134.
 Young, Tollefson, Zegers, and Caballero. *Phys Rev PER* 18.2 (2022): 020140.
 Young and Caballero. *Phys Rev PER* 17.1 (2021): 010144.
 Mikkelsen, Young, and Caballero. *Phys Rev PER* 17.1 (2021): 010109.

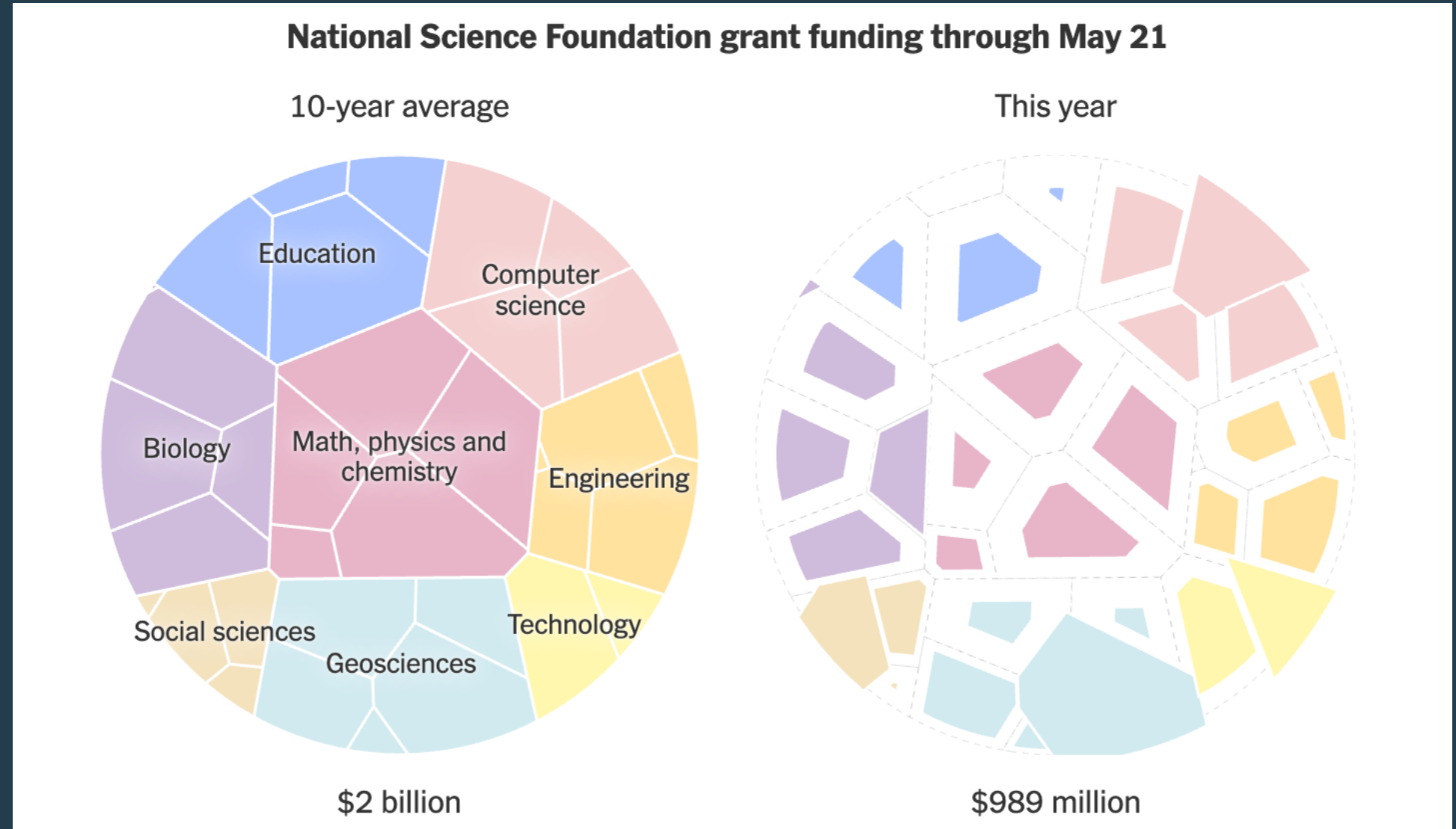
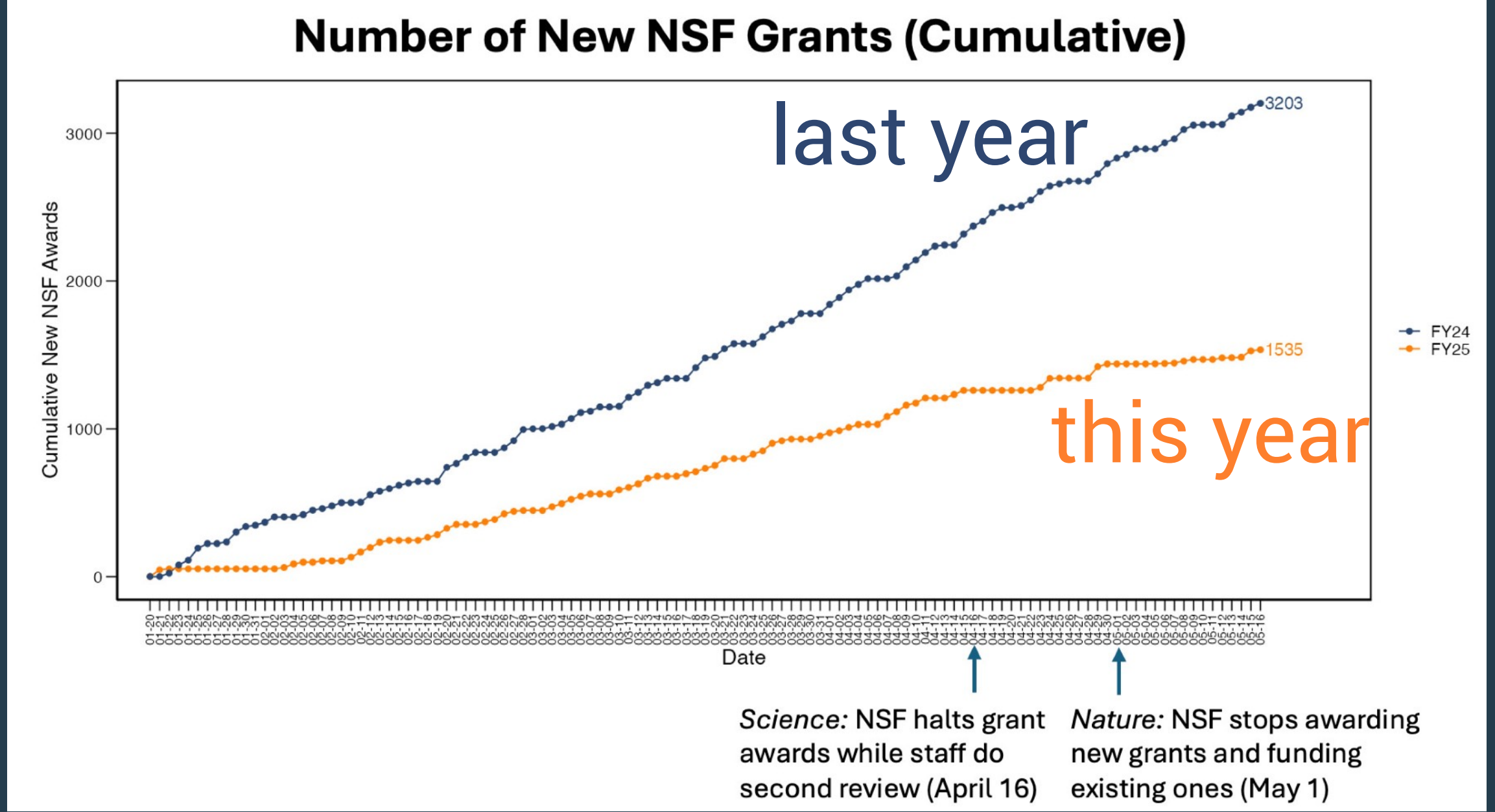
more folks learn
science better
greater diversity
across all of
science

a science that is more
representative of and
responsive to society

a society that deeply
values and strongly
supports science

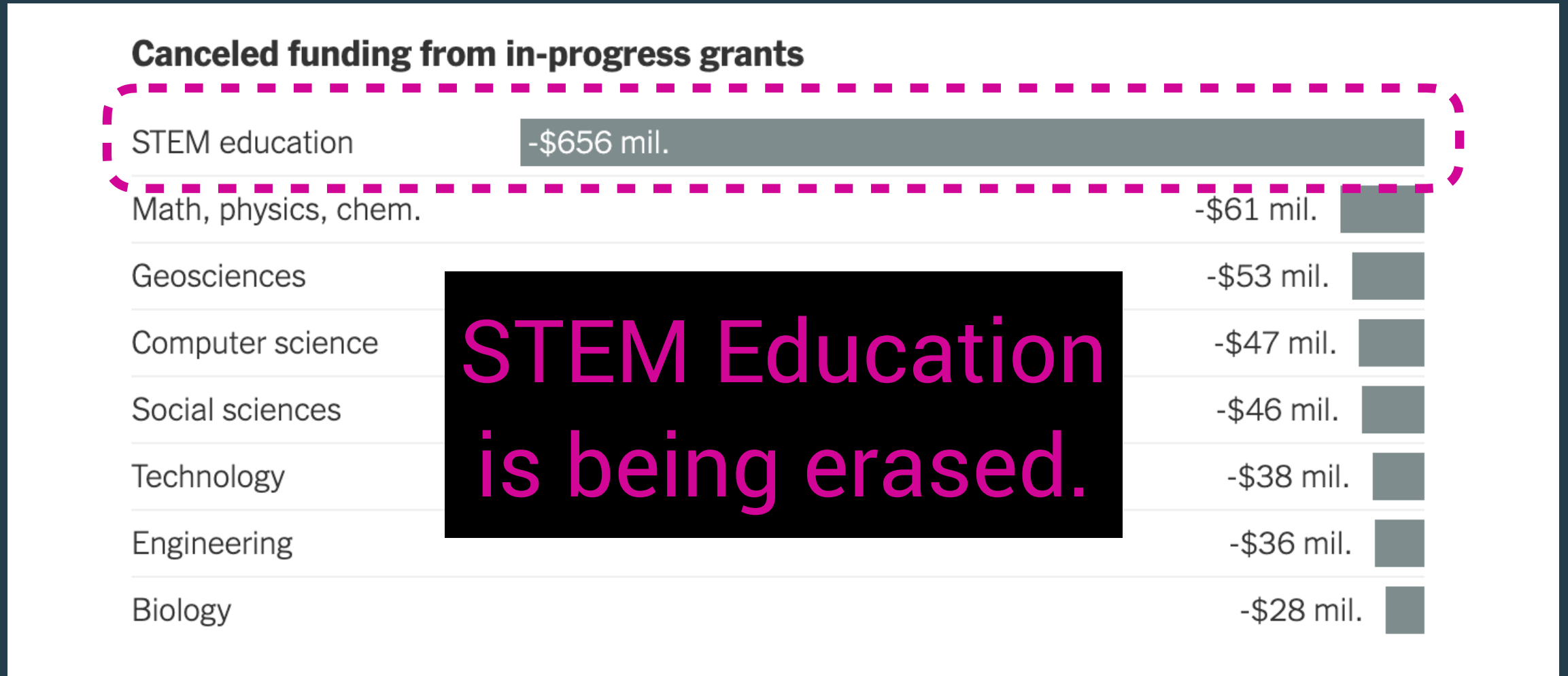
Since Jan 20, 2025 the Trump administration has strategically dismantled science and science education funding across programs, at different schools, and for all states.

The Trump administration is not awarding grants, cancelling programs, firing experts, installing unqualified & unserious people, and using coercive tactics to push compliance.



TheUpshot
Trump Has Cut Science Funding to Its Lowest Level in Decades

Terminated grants are twice as likely to impact women, four to five times as likely to impact researchers of color.



The impact is felt across all areas of science.



MICHIGAN

FY 2023 Fast Facts



\$262,641,000

Total NSF Awards to Michigan



\$205,630,000

Invested in Fundamental Research in Michigan



\$48,717,000

Invested in STEM Education in Michigan



\$8,837,000

Invested in Michigan Businesses

Top NSF-funded Academic Institutions for FY 2023

University of Michigan
\$132,296,000

Michigan State University
\$66,196,000

Michigan Technological University
\$15,188,000

NSF By The Numbers

The U. S. National Science Foundation (NSF) is an [\\$9.06 billion](#) independent federal agency created by Congress in 1950 to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense. NSF's vital role is to support basic research and researchers who create knowledge that transforms the future.

DID YOU KNOW?

NSF has funded the work of **261** Nobel Prize winners over 75 years.



\$9.06B
FY 2024
Total Enacted

93%
Funds research, education and related activities



11K
Awards



1.9K
Institutions



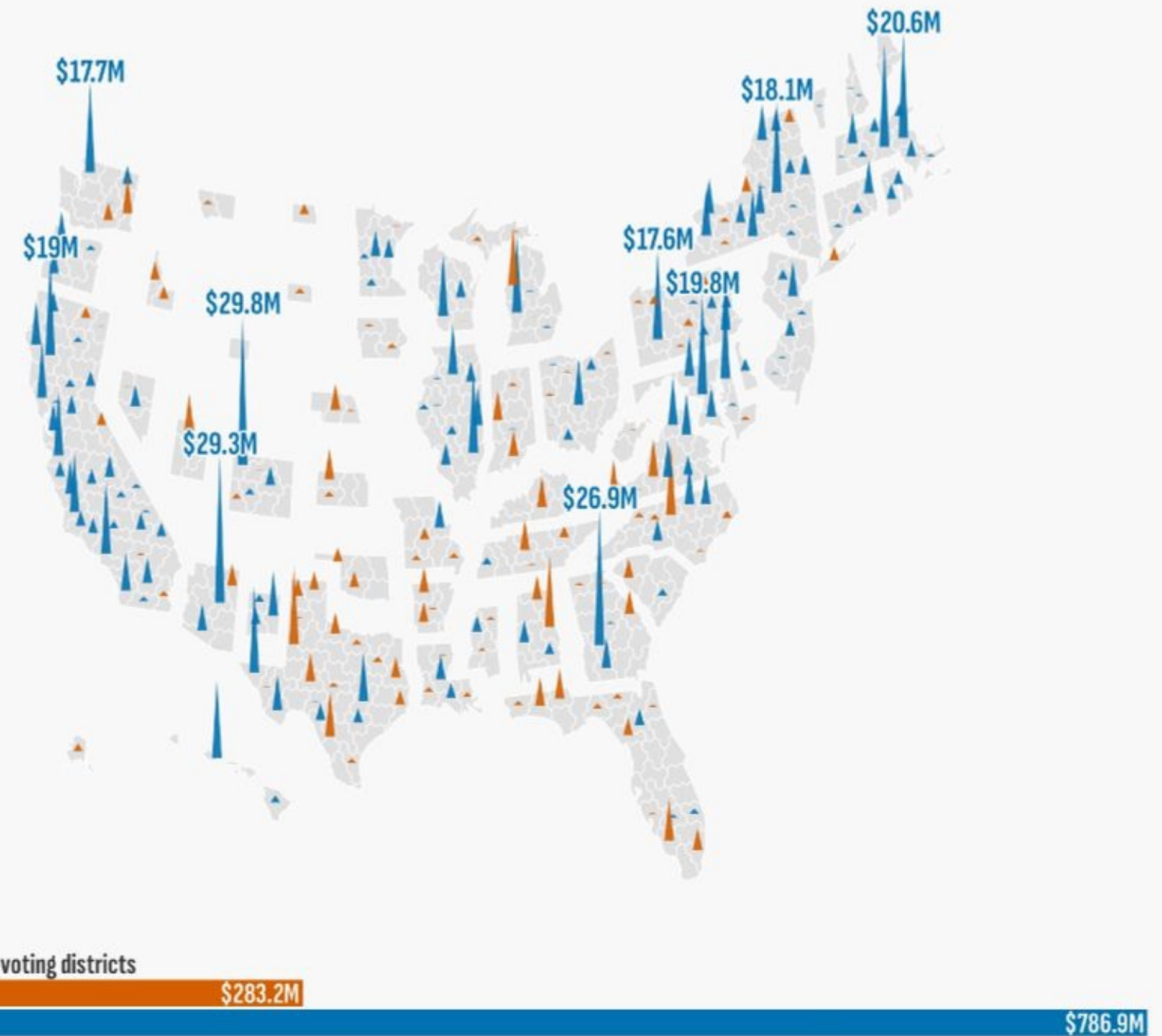
353K
People

*Data represents FY 2023 Actuals unless otherwise indicated

This administration's politicization of science is intentional and short-sighted.

NSF grant terminations disproportionately affect Democratic districts

Unprecedented National Science Foundation grant terminations by the Trump administration, part of a major restructuring and budget cuts, are impacting scientific research and education. As of 11 May 2025, 1 464 grants, totalling \$1.1B, were cancelled without appeal. Data, crowdsourced by Grant Watch due to lack of official release, shows funding lost aggregated per congressional district by party.



Sources: Grant Watch, Data.gov & The Downballot · Graphic: Georgios Karamanis

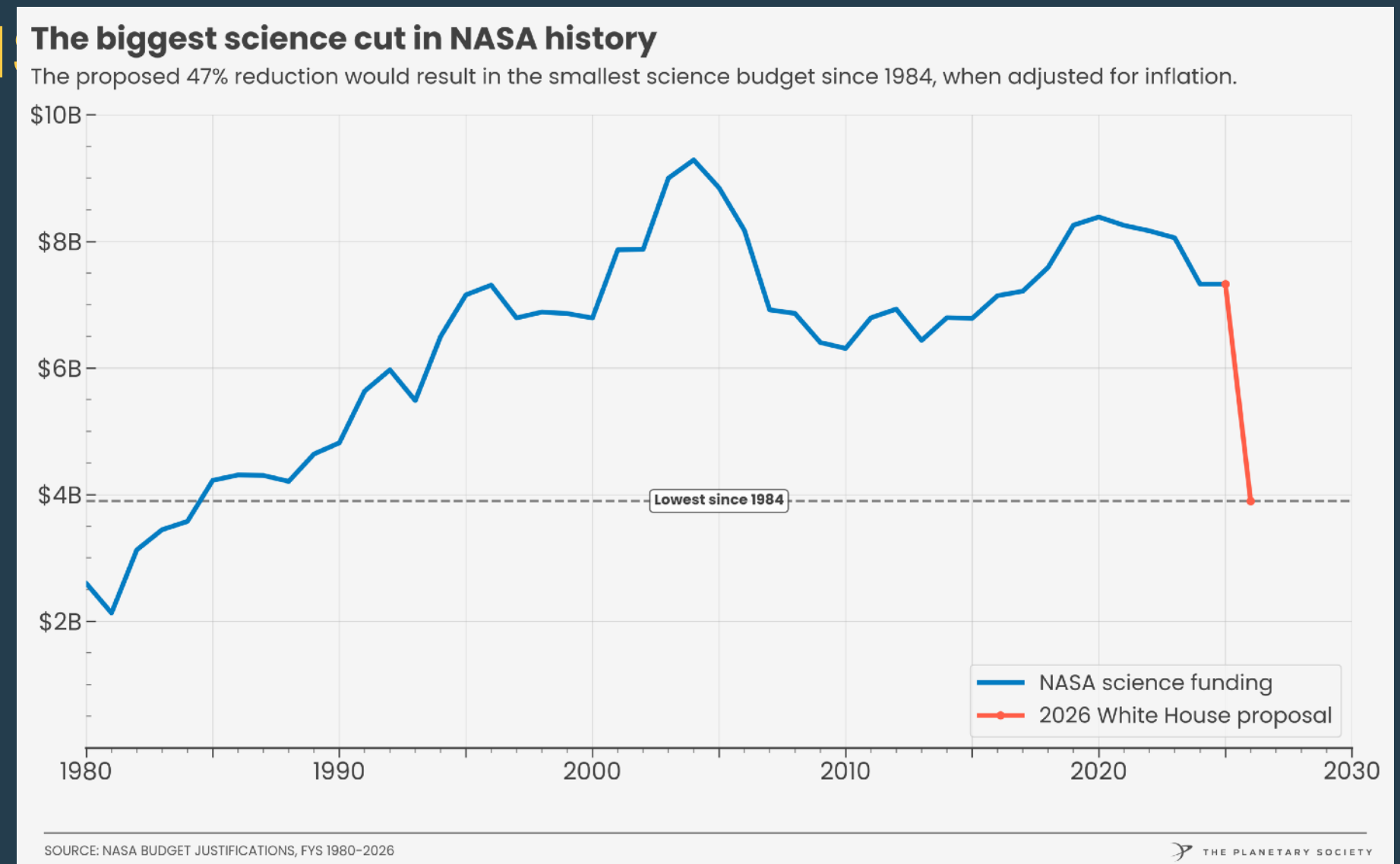
The state of Michigan has lost \$28M in federal grants so far. Real jobs have been lost and will continue to be.

An unprecedented attack on science and technology centers that has nothing to do with waste, fraud, or abuse

Program and Financing (in millions of dollars)

Identification code 091-1100-0-1-503	2024 actual	2025 est.	2026 est.
Obligations by program activity:			
0001 Research, development, and dissemination	232		
0002 Statistics	117		
0003 Regional educational laboratories	57		
0004 National Assessment	210	185	130
0005 National Assessment Governing Board	6	8	7
0006 Research in special education	70		
0007 Statewide longitudinal data systems	49		
0008 Special education studies and evaluations	12		
0009 Direct program activity (Program Administration)	67		
0010 Undistributed		600	124
0100 Total direct program	820	793	261
0799 Total direct obligations	820	793	261
0900 Total new obligations, unexpired accounts	820	793	261

Largest cut in history for NASA; \$12B of investment will be gone.



Science graduate and postdoc programs are being cut (FY26)

75% of IES budget to discretionary funding
House to cut total by 70% (\$560M)

Program	Percentage	2024 Actual	2025 Est.	2026 Est.
Focused Programs				
Advancing Informal STEM Learning (AISL)	100%	\$62.50	-	-
ADVANCE	100%	18.00	-	-
Alliances for Graduate Education & the Professoriate (AGEP)	100%	8.00	-	-
AGEP Graduate Research Supplements (AGEP-GRS)	100%	3.37	-	-
Broadening Participation in Biology Fellowships	100%	6.00	-	-
Broadening Participation in Engineering (BPE)	100%	7.02	-	-
Career-Life Balance (CLB)	100%	0.03	-	-
Centers of Research Excellence in Science & Technology (CREST)	100%	24.00	-	-
CISE Education and Workforce	100%	14.75	-	-
CISE Graduate Fellowships (CSGrad4US)	100%	8.50	-	-
CISE-MSI Research Expansion Program	100%	7.00	-	-
Disability and Rehabilitation Engineering (DARE)	100%	5.00	-	-
Eddie Bernice Johnson INCLUDES Initiative (INCLUDES Initiative)	100%	23.33	-	-
Enabling Partnerships to Increase Innovation Capacity (EPIIC)	100%	20.00	-	-
Excellence Awards in Science & Engineering (EASE)	100%	2.20	-	-
ExpandAI	100%	7.50	-	-
ExpandQISE	100%	18.50	-	-
Growing Research Access for Nationally Transformative Economic Development (GRANTED)	100%	34.50	-	-
HBCU Excellence in Research (HBCU-EIR)	100%	25.00	-	-
Historically Black Colleges & Universities Undergrad Prog (HBCU-UP)	100%	36.50	36.50	20.00
Improving Undergraduate STEM Education (IUSE): CUE Program	100%	7.50	-	-
IUSE: Hispanic Serving Institutions (HSI) Program	100%	46.50	-	-
Louis Stokes Alliances for Minority Participation (LSAMP)	100%	49.50	-	-
MPS Ascending Postdoctoral Research Fellowships (MPS-Acend)	100%	8.25	-	-
MPS Partnerships for Research & Education	100%	18.36	-	-
NSF Scholarships in STEM (S-STEM)(H-1B) ¹	100%	[144.41]	[112.85]	[112.85]
Research and Mentoring for Postbaccalaureates in Biological Sciences (RaMP)	100%	-	-	-
SBE Build and Broaden	100%	6.00	-	-
SBE Postdoctoral Research Fellowships-Broadening Participation (SPRF-BP)	100%	1.50	-	-
Science of Broadening Participation	100%	1.50	-	-
Tribal Colleges & Universities Program (TCUP)	100%	16.50	-	7.11

~30 broadening participation* programs are being zeroed out (FY26).

	FY 2024 Current Plan	FY 2025 (TBD)	FY 2026 Request	Change over FY 2024 Current Plan	
				Amount	Percent
Fellowships and Scholarships	\$472.52		\$167.22	-\$305.30	-64.6%
CyberCorps®: Scholarship for Service (SF5)	63.00		21.71	-41.29	-65.5%
Graduate Research Fellowship Program (GRFP)	284.52		127.29	-157.23	-55.3%
NSF Research Traineeship (NRT)	58.00		-	-58.00	-100.0%
NSF Scholarships in STEM (S-STEM) (H-1B) ¹	[144.41]		[112.85]	[-31.56]	[-21.9%]
Robert Noyce Scholarship (Noyce) Program	67.00		18.22	-48.78	-72.8%
Postdoctoral Programs	\$65.03		\$5.62	-\$59.41	-91.4%
Astronomy and Astrophysics Postdoctoral Fellowships	2.40		-	-2.40	-100.0%
Engineering Postdoctoral Fellowships (eFellows)	3.00		-	-3.00	-100.0%
Entrepreneurial Fellowships	4.12		4.12	-	-
Geosciences Postdoctoral Fellowships	10.80		-	-10.80	-100.0%
Mathematical Sciences Postdoctoral Research Fellowships	8.36		-	-8.36	-100.0%
MPS ASCEND Postdoctoral Research Fellowships	8.25		-	-8.25	-100.0%
Postdoctoral Research Fellowships in Biology (PRFB)	17.10		-	-17.10	-100.0%
SPRF-Broadening Participation	1.50		-	-1.50	-100.0%
SPRF-Fundamental Research	1.50		1.50	-	-
STEM Education Postdoctoral Research Fellowships	8.00		-	-8.00	-100.0%
Total	\$537.55		\$172.84	-\$364.71	-67.8%

*by federal statute NSF must work to broaden participation across science

¹ Totals exclude H-1B visa funded programs (S-STEM)

Implications

The “brain drain” is happening

- Other countries are actively recruiting U.S.-trained talent.
- We are dismantling the very programs that train the next generation.
- The U.S. is facing a historic decline in its scientific workforce.
- America’s leadership in science and innovation is at risk.

If we choose to continue down this path, we will be less safe, less informed, less economically secure, and less prepared for the major challenges that face us.

What can you do?

Thank you for coming tonight. It's an important start.

- Sit with this information and reflect
- Learn more about the impact of funding cuts (grant-watch.us)
- Read about the house budget's impact on science (science.org)
- Show up to support science (standupforscience.net)
- Call or write your representatives (democracy.io)
- Talk to your family and friends (we all benefit from strong science)

SCIENCE
is **NOT** a Liberal Conspiracy

Science is a **messy and nonlinear process** by which we develop a **reproducible and predictable** understandings of the natural world.

Science:

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- affects every person in and outside the U.S.

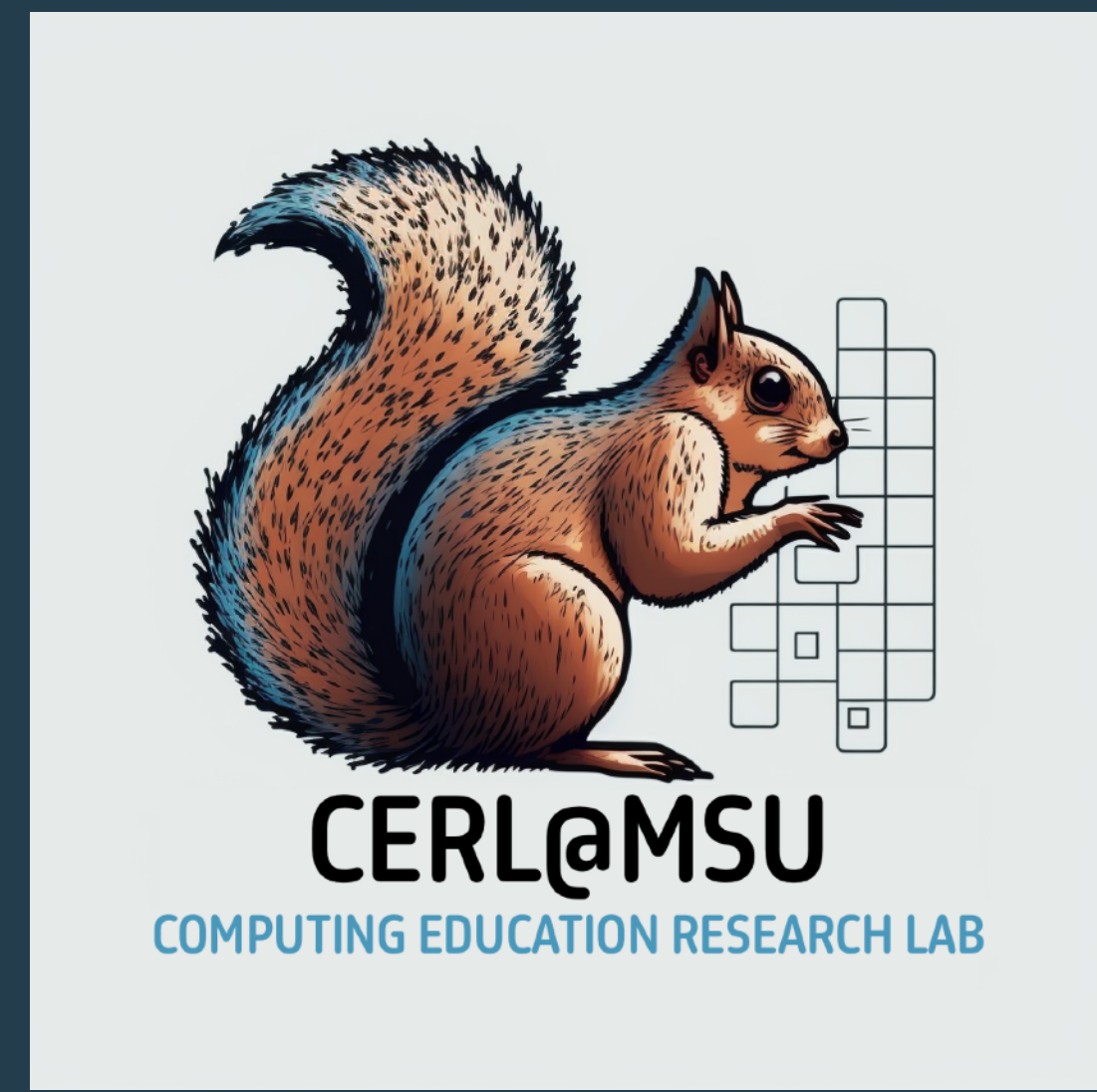
¿questions?

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PERL @MSU



And thanks to our sponsors



Since November 2011

Danny Caballero

github.com/dannycab

13 followers · 2 following

Michigan State University East Lansing, MI

@physicistdanny



I stand with my queer and undocumented family, friends, and colleagues.

