EDI in Physics and Engineering

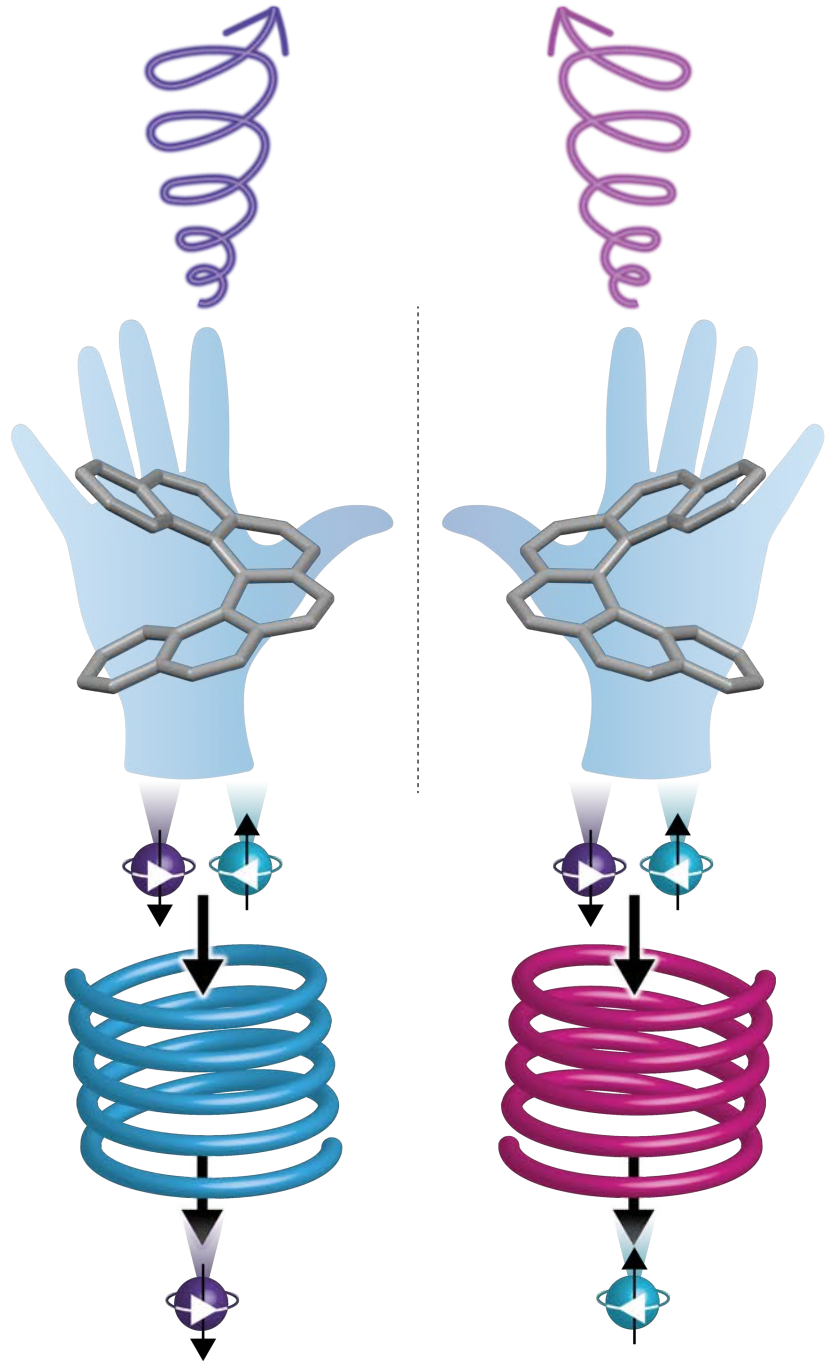
Dr Jess Wade

Imperial College London

November 7, 2023

Imperial College London

University of the Arts London



Imperial engineers!

Roma Agrawal
Structural engineer (the Shard), author and broadcaster

Richard Parasram
Head of Delivery, Office for Quantum Technologies at Department for Science

Chi Onwurah
Labour MP for Newcastle
Shadow Minister (Science, Research and Innovation)

What's the problem?

- 20% of A-Level physics students are women[1]
- 0.5% of A-Level physics students are Black Carribean[1]
- Girls are 2.5x more likely to study physics at an all-girls private school[1]
- 70% of physics students come from 30% of schools, less affluent = less likely[1]

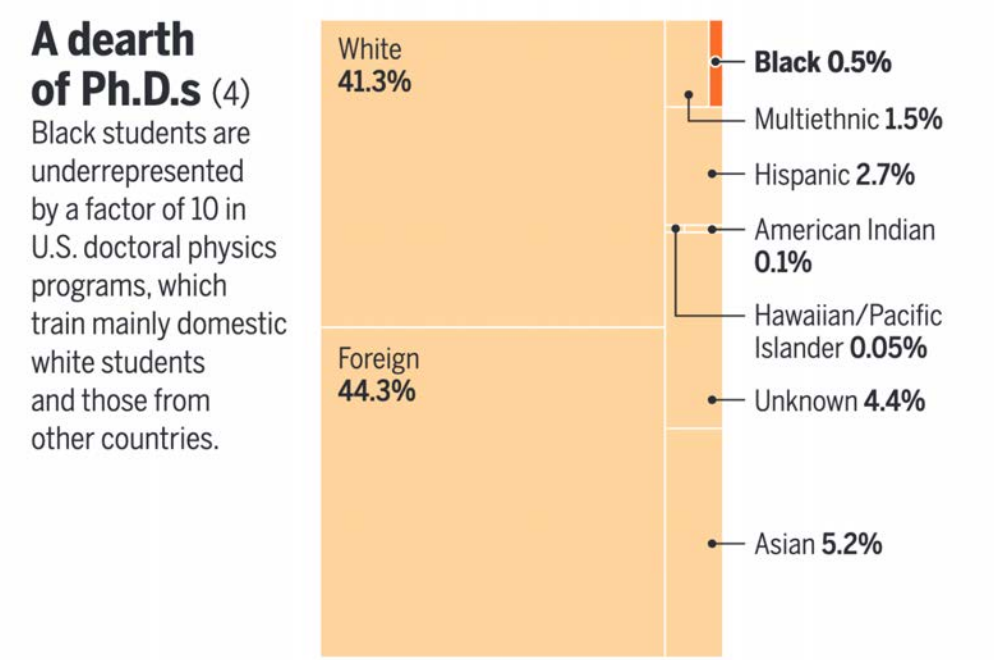
Table 9. Percentage change in A level entries in summer 2023 compared to summer 2022

Subject grouping	Entries in Summer 2022	Entries in Summer 2023	Percentage change in entries
Mathematics	89,605	90,845	1.4%
Psychology	76,265	78,015	2.3%
Biology	66,220	68,870	4.0%
Chemistry	54,865	57,620	5.0%
Sociology	43,590	45,730	4.9%
History	42,885	44,545	3.9%
Business studies	38,980	41,265	5.9%
Art and design subjects	42,100	40,930	-2.8%
Economics	35,760	38,325	7.2%
Physics	36,770	35,815	-2.6%
Geography	34,245	34,870	1.8%
English literature	32,910	34,000	3.3%

1 various IOP reports, https://www.iop.org/sites/default/files/2020-11/IOP-Limit-Less-report-2020-Nov.pdf
2 https://www.gov.uk/government/publications/national-quantum-strategy
3 https://doi.org/10.1103/PhysRevPhysEducRes.15.010121
4 https://www.science.org/topic/tags/missing-physicists
5 https://journals.aps.org/prper/abstract/10.1103/PhysRevPhysEducRes.18.010124
6 https://www.lse.ac.uk/tii/assets/documents/The-City-Quantum-Summit-TII-Report.pdf

What's the problem?

- 20% of physics undergrads in the UK are women
- 75% of women physics UGs in USA experience harassment in physics[3]
- 3% of physics undergrads (16% of all undergrads) and < 1% of PhD physicists in US are Black[4]
- 36% of LGBTQ+ physicists consider leaving their workplace because of exclusionary behaviour[5]



1 various IOP reports, https://www.iop.org/sites/default/files/2020-11/IOP-Limit-Less-report-2020-Nov.pdf
2 https://www.gov.uk/government/publications/national-quantum-strategy
3 https://doi.org/10.1103/PhysRevPhysEducRes.15.010121
4 https://www.science.org/topic/tags/missing-physicists
5 https://journals.aps.org/prper/abstract/10.1103/PhysRevPhysEducRes.18.010124

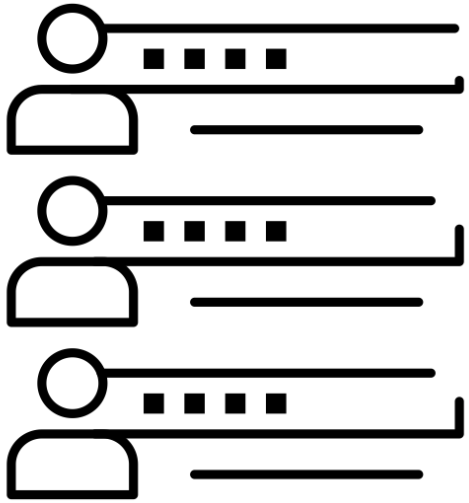
ROYAL SOCIETY OF CHEMISTRY

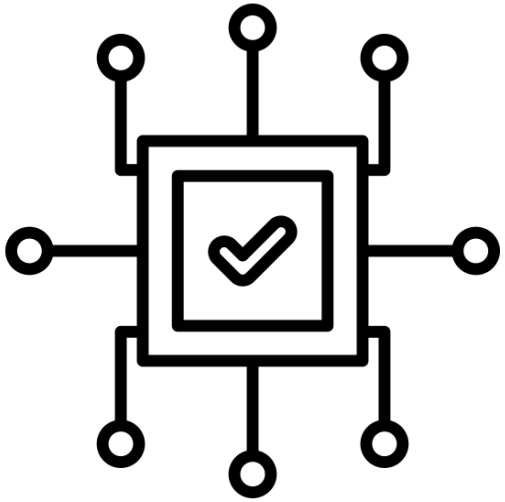
SCIENCE CULTURE

Missing Elements

Racial and ethnic inequalities in the chemical sciences

Why should you care?






children and young people
early career
established researchers and leaders

What can we do?

Toni Morrison
Nobel Prize for Literature, 1993

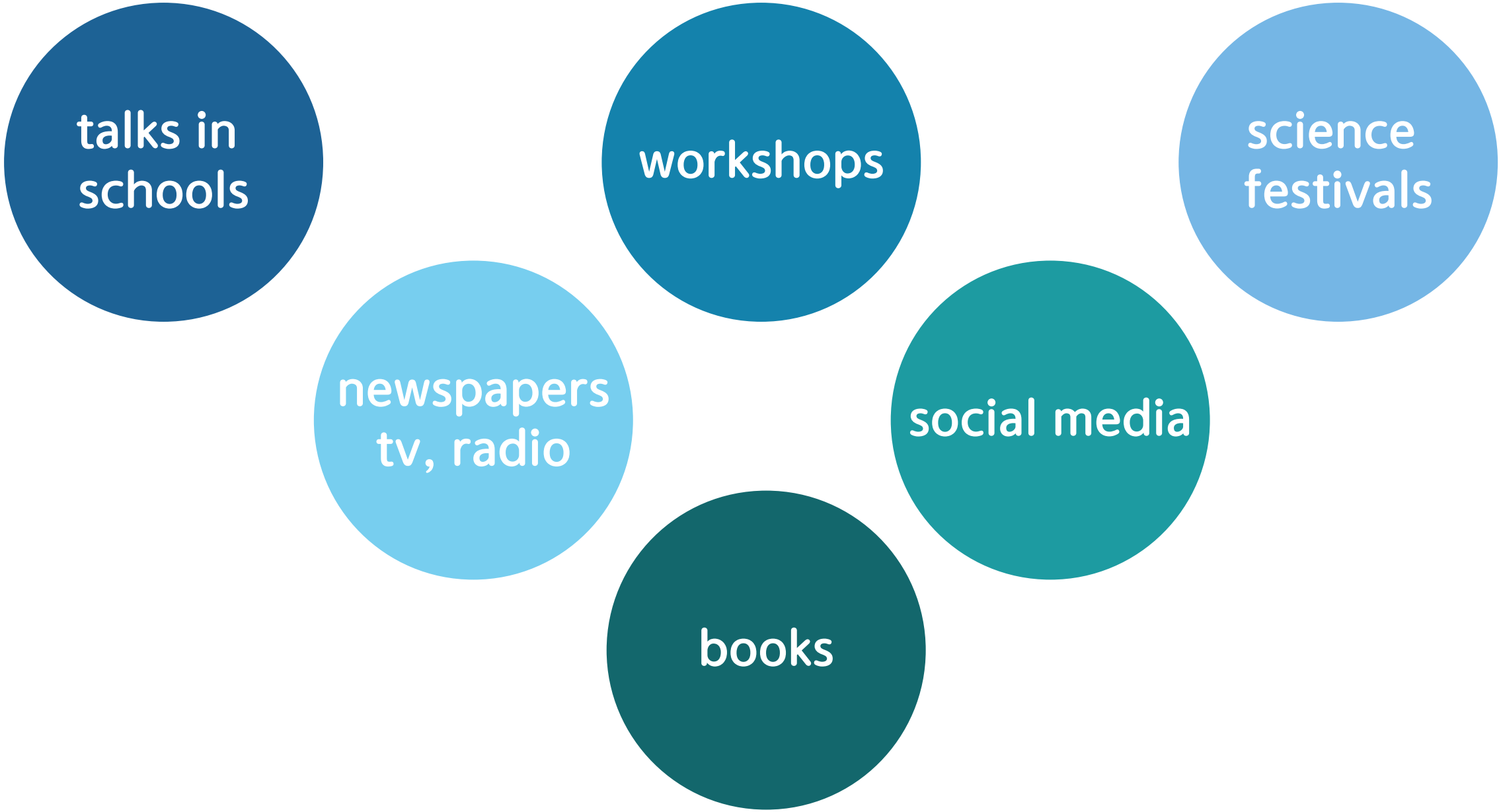
‘I tell my students, “When you get these jobs that you have been so brilliantly trained for, just remember that your real job is that if you are free, you need to free somebody else.

If you have some power, then your job is to empower somebody else.”’

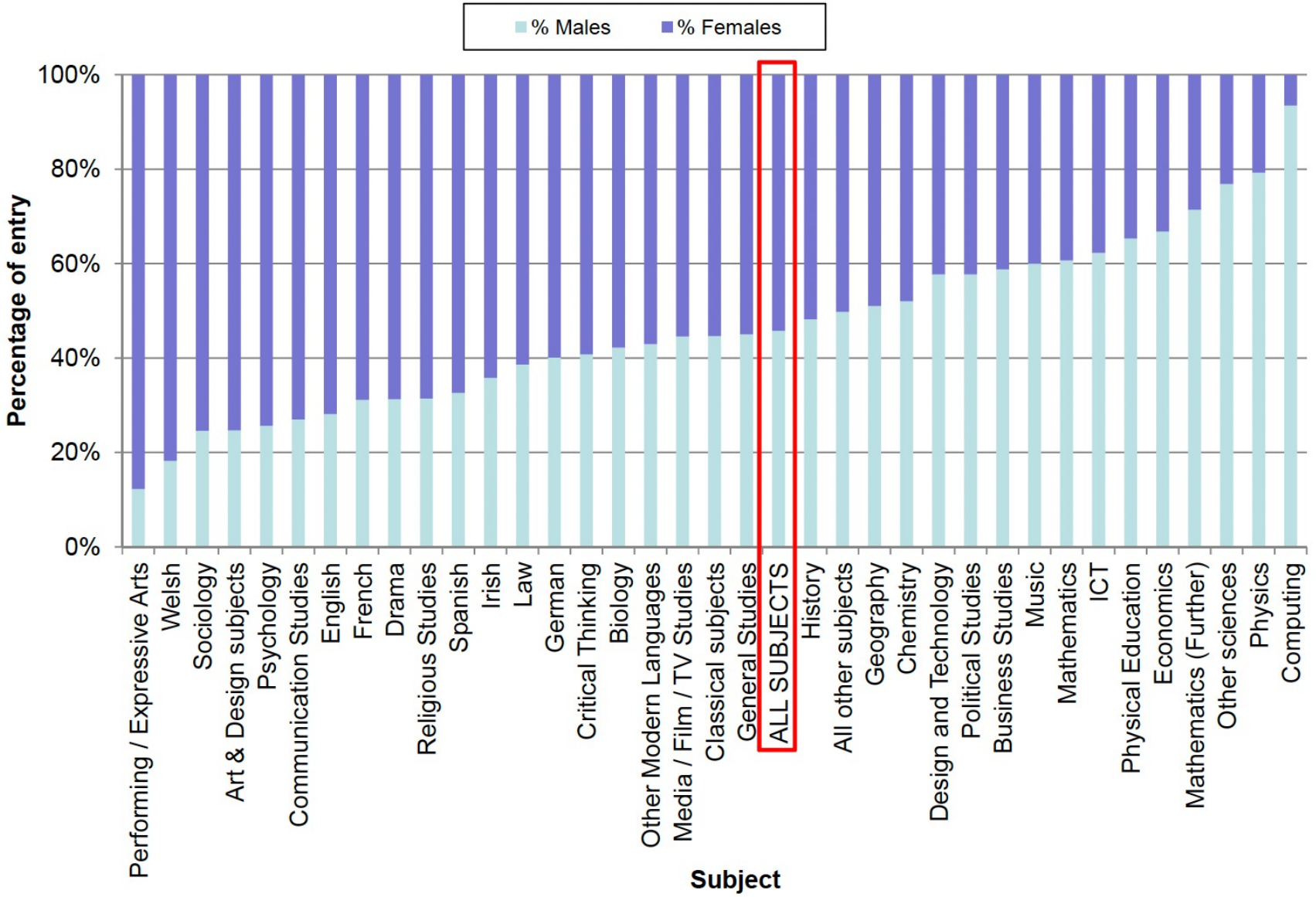
Carl Wieman
Nobel Prize for Physics, 2001

“Recognize that success in physics has little to do with talent and a great deal to do with educational privilege.”

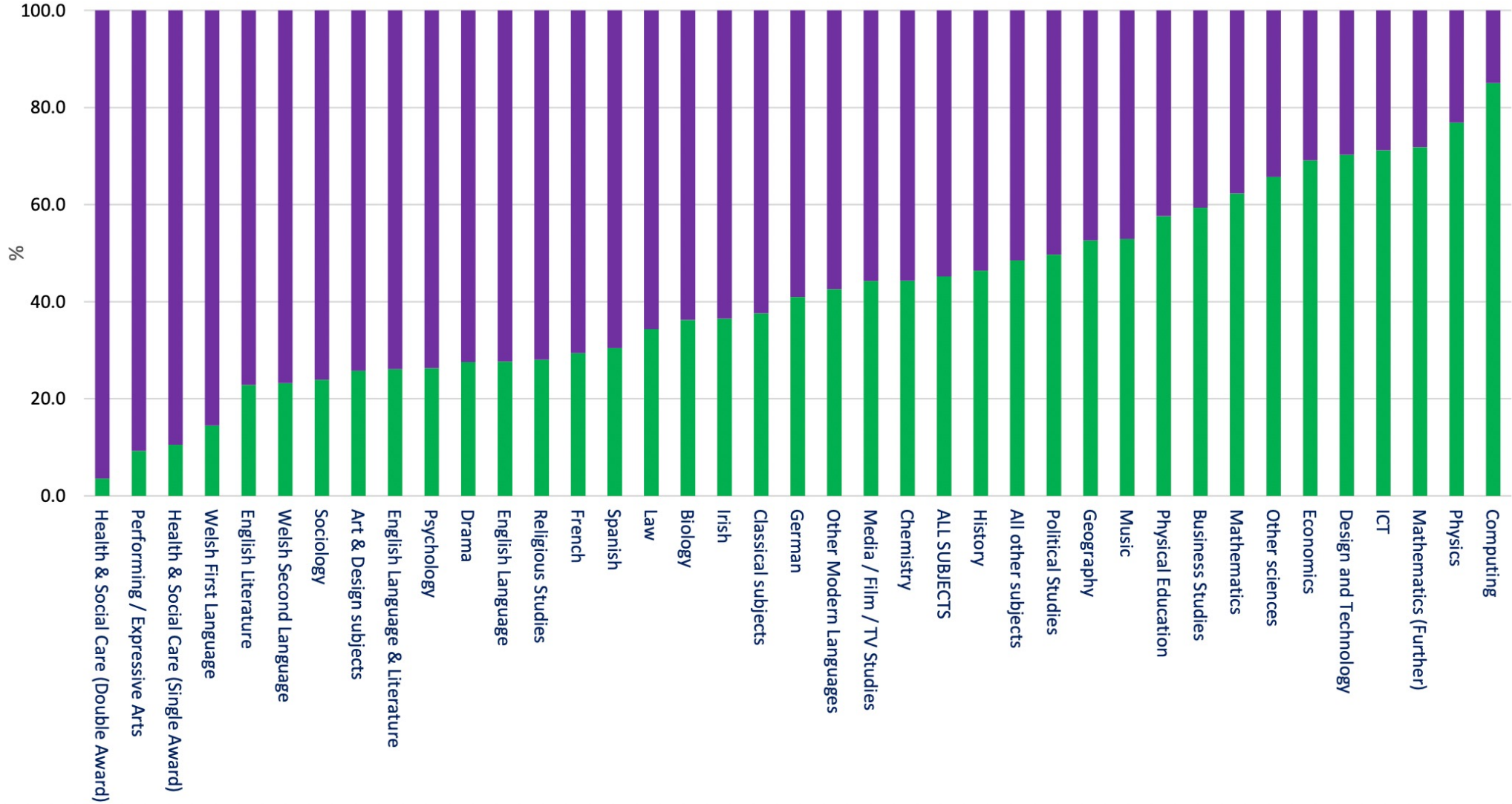
high school students.


talks in schools
workshops
science festivals
newspapers tv, radio
social media
books

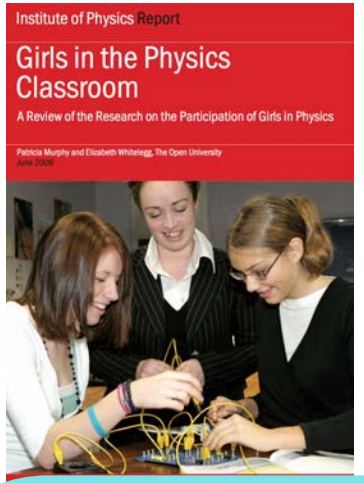
Men and women's A-Level choices 2013

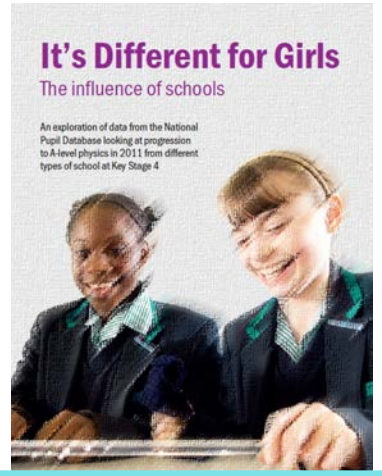


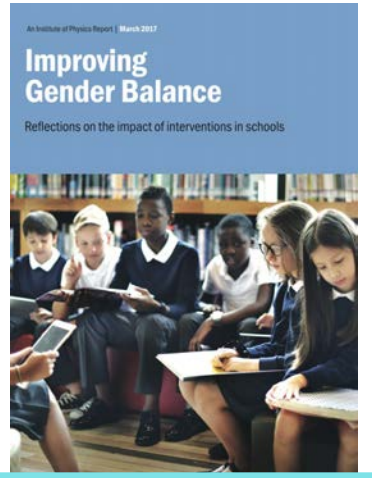
Men and women's A-Level choices 2022



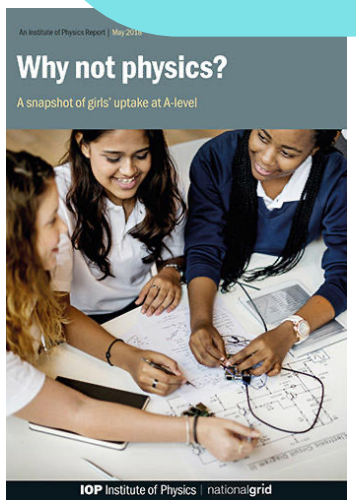
https://www.jcq.org.uk/wp-content/uploads/2022/08/GCE-Entry-Gender-and-Regional-Charts-Summer-2022-.pdf

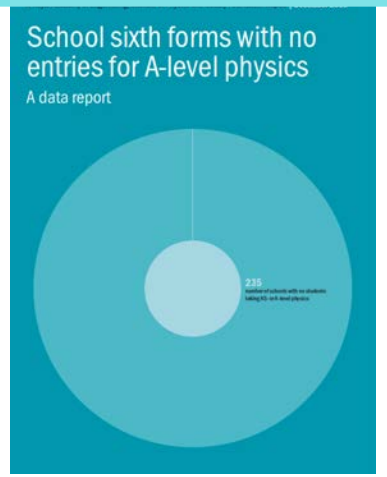


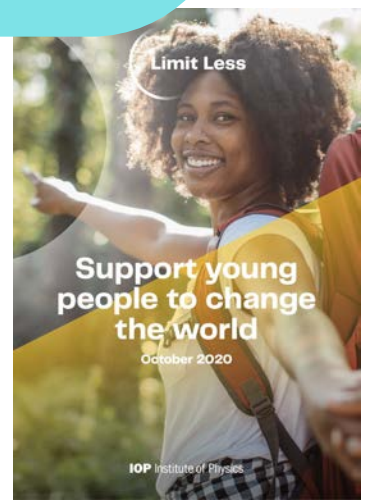


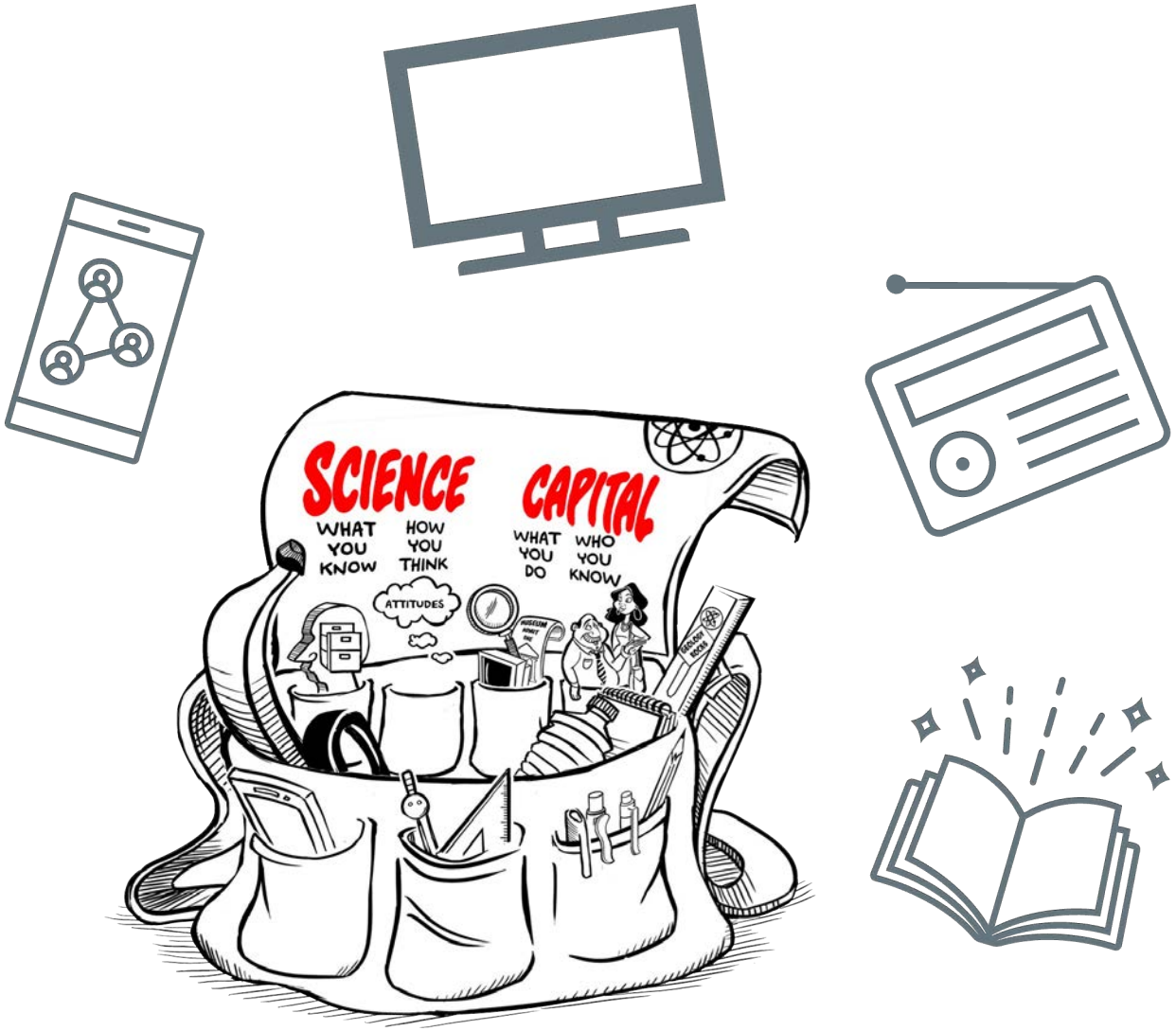


evidence-based outreach








SCIENCE
CAPITAL
WHAT YOU KNOW
HOW YOU THINK
WHAT YOU DO
WHO YOU KNOW
ATTITUDES

Essential features of good practice in countering gender stereotyping in schools

Based on the discussions and observations that took place within the site visits and subsequent recommendations given to schools, the following are the essential features of a school that is actively addressing gender equity. The next section explores these, and other, aspects of good practice in more detail.

1 Senior gender champion

Senior Leadership Teams identify one of their number as a gender champion whose role includes bringing together the whole school in a coherent campaign to challenge gender stereotypes. Governors are involved in the campaign in order to reinforce the message that this activity is a priority.

2 Training

Staff attend gender awareness and unconscious bias training, whether as part of their induction to the school or their ongoing professional development.

3 Sexist language

Sexist language is treated as being just as unacceptable as racist and homophobic language. Teachers receive training on unconscious bias and equality and diversity awareness.

4 Use of progression data

Gender-disaggregated data on both achievement and progression are collected for all subjects and discussed formally at whole-school level, using benchmark data for comparison. Where there are issues to be addressed, actions are generated, including targets where appropriate.

5 Initiatives

Initiatives are introduced and developed on the basis of what works and in a way that shows how they address a problem identified in the school data. Carefully planned external visits encourage students to challenge stereotypical views as do role models

resources and activities. Sessions on equality and diversity form the basis of a wider school campaign and discussions on these themes continue through other topics.

9. Student experience

9.1. Engaging students in countering stereotyping

In all schools visited, students were very aware of gender issues in school, at home or in the media. In many cases they were much more engaged with these issues than their teachers believed. Lots of students, male and female, reported living with a daily barrage of sexist "banter", and were aware that some of their behaviours and subject choices are heavily gendered, and often driven by peer pressure. Despite this awareness, most students still found it difficult to break out of their roles, and many girls, in particular, passively accepted the situation. More positively, there were some cases of students taking the initiative in setting up feminist/equality societies, awards for teachers who challenge sexist behaviour, and other similar activities.

Good practice: *There is a great deal of potential in engaging students with gender issues. Any initiatives should be seen as being in partnership with the students, not as something done to them. One very positive activity is to use the students as ambassadors, working either with pupils lower down the school or with local primary schools to raise awareness of, and to counter, gender bias.*

I'm a Scientist Get me out of here

Home | Take Part | Fund | Find Your Zone! | About | Contact Us

Students connect with working scientists

I'm a Scientist is an online, student-led STEM enrichment activity. It connects school students with scientists through energetic real-time text based chats.

The activity is running throughout the year.

Find out more and take part this term:

- Teachers ›
- Scientists ›
- Funders ›

Jessica Wade

We're raising £20,000 to buy a copy of Inferior: How Science Got Women Wrong and the New Science that's Rewriting the Story for EVERY state school in the UK.

Add location

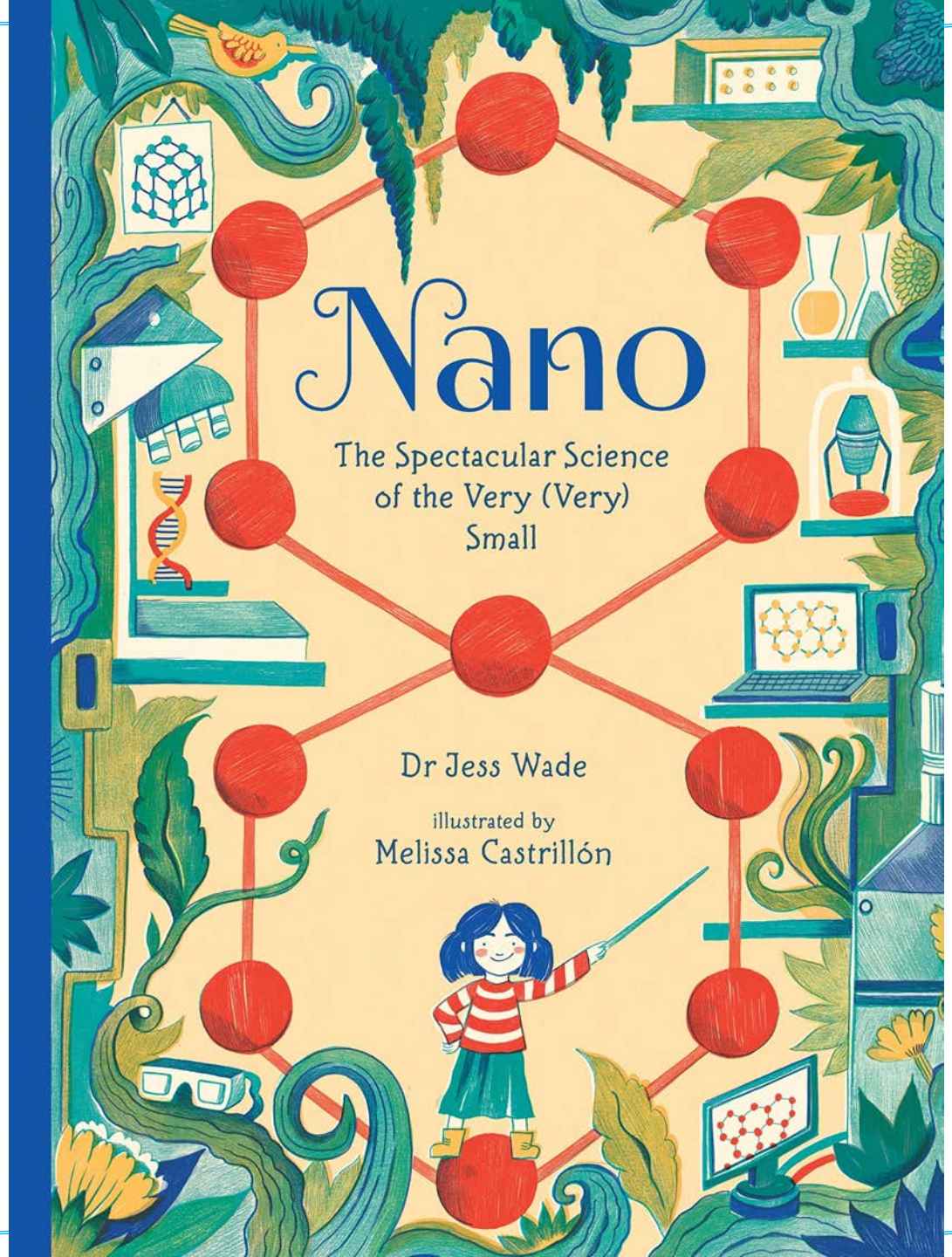
Schools and education

113%

£22,781

raised of £20,000 target by

890 supporters


Nano
The Spectacular Science of the Very (Very) Small
Dr Jess Wade
illustrated by
Melissa Castrillón

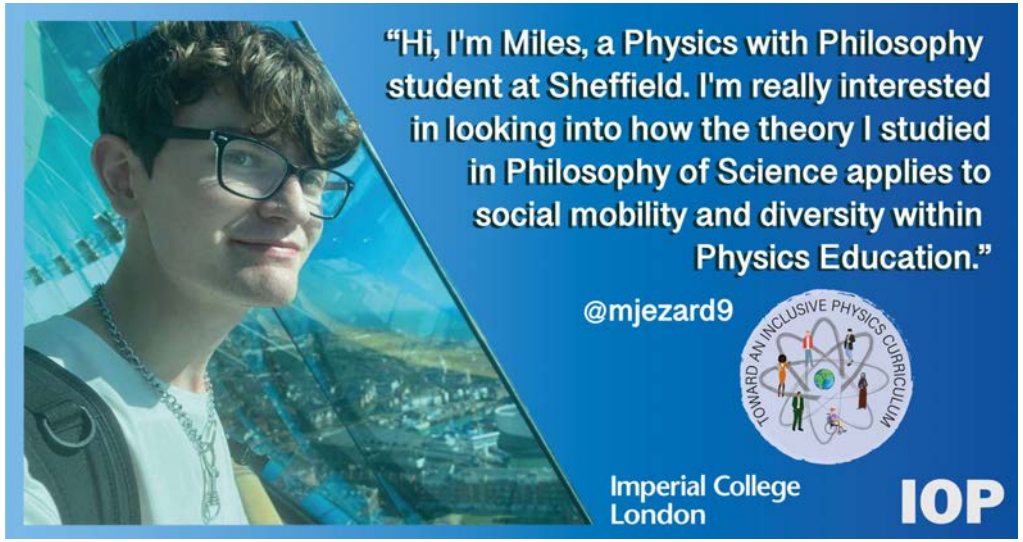
undergrads.

"Hi! I'm Emily, a 2nd year Astrophysics student at Lancaster University from Liverpool. I'm really excited about this project since I'm very passionate about battling gender equality & stereotypes in physics through scientific communication."

@emwalls1

Imperial College London

IOP

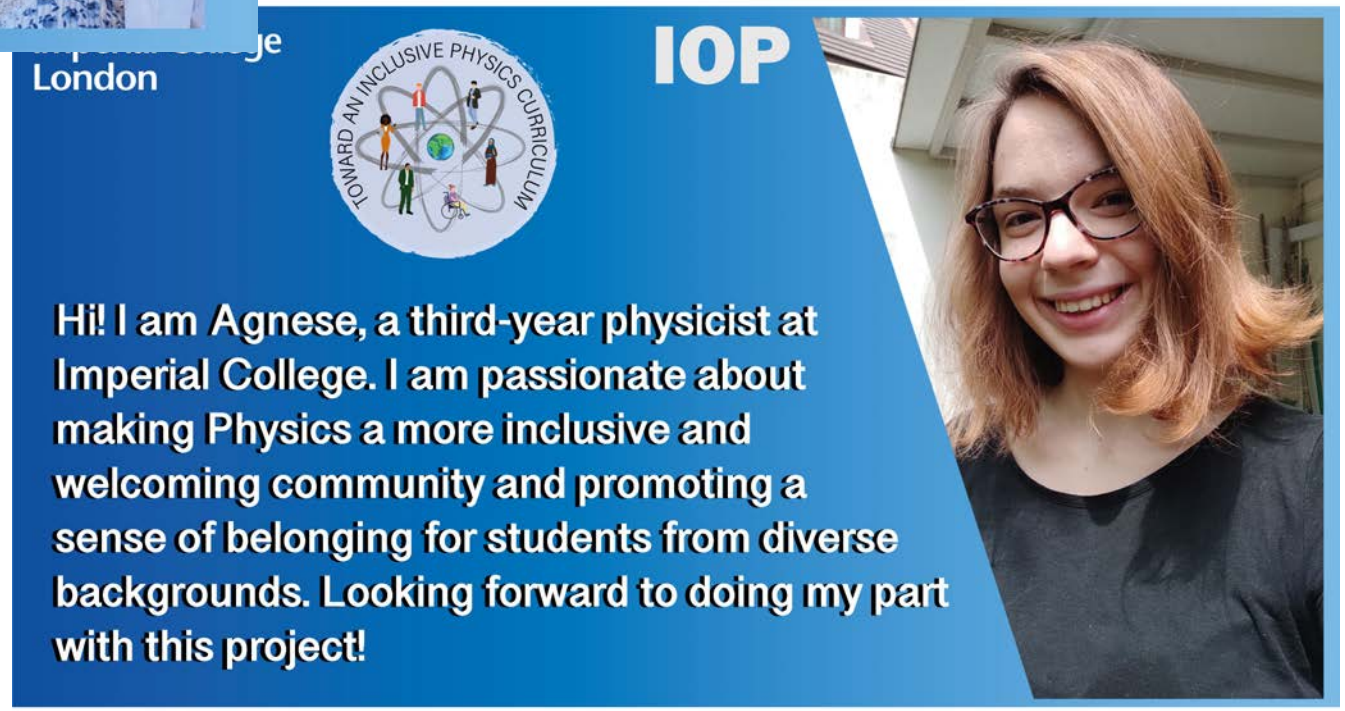


Hi, I'm Moriah, a Physics student at Imperial College London. I'm looking forward to playing a part in diversifying the physics curriculum so that students from diverse backgrounds feel more comfortable in their physics departments and are less likely to feel imposter syndrome.

@moriahsan1

Imperial College London

IOP



project timeline

create best practise guide

create website & database

report findings at and host student-led education conference

AUGUST 2022

OCTOBER 2022

JULY 2022

project start

SEPTEMBER 2022

ViCE PHECC

document findings in a report

NOVEMBER 2022

literature search

curriculum review

develop inclusive teaching resources

launch website & database

IOP Institute of Physics

HOW TO MAKE LABS MORE INCLUSIVE

1 Have a disability representative involved in labs

- Strong communication between individual student needs and technical staff.
- Departments can plan for potential students with different impairments and can make reasonable adjustments so that all students can access labs.

2 Switch to electronic lab books

- Switching from paper to electronic lab books is more environmentally friendly & allows for disabled students to use their own computers which are already tailored for their own needs.
- Plus these can then be marked remotely in a more efficient way for lab tutors.

3 Produce lab introduction videos

- Reduces stress for students with mental health and mobility issues before entering labs so they know exactly what to expect.

4 Allow for remote lab access

- Accessible for every student with computer access, students can work together via applications such as Microsoft Teams and encourage teamwork and discussion.

5 Have regular review meetings

- Regular discussions and sharing of expertise to embed good practice.
- Document support strategies for future provision and students.

[1] Building momentum towards inclusive teaching and learning A good-practice guide for undergraduate physics, IOP, 2017

IOP Institute of Physics

5 WAYS TO PRODUCE INCLUSIVE EXAM QUESTIONS

FLOW CHART

1 USE REAL WORLD PROBLEMS

Allows students to be in touch with ongoing problems globally which can cover a vast amount of issues socially, politically, economically and environmentally.
Physics graduates are equipped with the knowledge but need to be able to apply it to any environment to improve their transferrable skills.

2 ENCOURAGE PROBLEM SOLVING

By highlighting how physics helps people in application. It encourages a greater level of problem solving skills than many exams currently feature.

3 COVER PROTECTED CHARACTERISTICS

Brings cultural awareness that students may have not already been exposed to and increases representation throughout degree schemes.

4 PHYSICS IS A SOLUTION NOT A SAVIOUR

Its important to stress not accidentally making exam questions too white-saviour like, these are problems that physicists in these countries can apply physics to solve themselves.

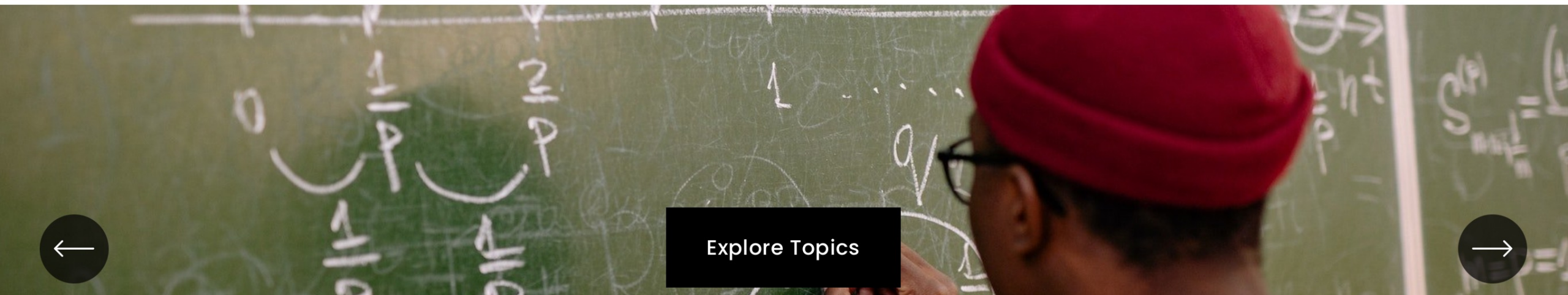
There have been cases of medical equipment being sent to nations that cannot generate enough power to actually use these machines, questions should avoid accidentally glorifying similar processes.

5 GIVE HISTORICAL CONTEXT

Giving recognition and integration of contributions of people from historically marginalized groups (e.g. non-white, non-male, and non-European) brings more awareness to students. Whilst opening a pathway for discussions to be held about the historical context that physics was discovered in.

Inclusive Physics Curriculum Project

This project looks at the current inclusion of equality, diversity and inclusion in the physics curricula in three UK universities. It highlights global best practice and produces resources to empower teaching staff to diverse their curricula and assessment methods.



summer students!

early career researchers

‘hidden curriculum’

writing papers, making figures, making posters, giving talks, writing proposals, applying for positions, collaborating, finding a mentor, interviewing, negotiating a contract, teaching, group discussions, running meetings, appointing a team, leading a group, building a network, joining a committee …

THE BLACKETT LAB FAMILY

SUMMER RESEARCH SCHOOL

June 29th – July 1st

Venue: Blackett Laboratory, Imperial College London
Deadline to apply: 9 May 2022
For **more information** and to **apply**, please visit:
theblackettlabfamily.com/rising-stars
Questions, please e-mail: jessica.wade@imperial.ac.uk

RISING STARS

13 January 2023 | 09:30 - 17:00

Royce Hub Building, Manchester

For Women in Science

UNESCO FONDATION L'ORÉAL

ROYAL SOCIETY OF CHEMISTRY

Moscone West Community Park

Meet colleagues throughout the week to reconnect and expand your network

Join us in the Moscone West Community Park—a place for everyone. You can attend networking and professional development events, learn how diversity drives success on global collaborations—or just relax and recharge between sessions.

EVENT	CATEGORY	LOCATION
Lunch and Learns	EDI/Professional Development	Community Lounge
SPIE Community Development Showcase	Membership/Professional Development	Community Lounge
Women in Optics Meetup	Community Networking	Community Lounge
LGBTQ+ Social	Community Networking	Community Lounge
SPIE Student Member Meetup	Community Networking	Community Lounge
Black in Photonics Meetup	Community Networking	Community Lounge
Career Lab Connection Reception	Community Networking	Community Lounge
First Timers' Reception	Community Networking	Community Lounge
Student and Early Career Networking Reception	Community Networking	Community Stage
The Great Career Showdown	Professional Development	Community Stage
Paws for a Break	Social and Networking	Community Park

PROFESSIONAL DEVELOPMENT

Enjoy four powerful days of career development and job skills advancement with the SPIE Career Hub at Photonics West. Build these focused events and services into your schedule and use the opportunity to make valuable connections.

Lunch and Learn: Beaded Privilege

29 January 2023 • 12:00 PM–1:00 PM
Moscone Center, Community Lounge (Level 2 West)

Join us for lunch and learn about diversity and inclusion in the optics and photonics industry.

FACILITATOR
Jessica Wade

Survey Says These Skills Are Missing in Today's Workforce: A Workshop on Essential Career Skills Part A

30 January 2023 • 9:00 AM–12:00 PM
Moscone Center, Room 2000 (Level 2 West)

Learn from experts in the field what skills you need to excel in the job market. Attend Part A and B as a track or individually as your schedule allows.

Lunch and Learn: Drive Change—Start Where You're At

30 January 2023 • 12:00 PM–1:00 PM
Moscone West, Level 2 Community Lounge

Join us for lunch and learn how to use your sphere of influence to build a culture and a company you're proud of.

PRESENTER
Michele Nichols

Lunch and Learn: Implicit Bias in STEM

31 January 2023 • 12:00 PM–1:00 PM
Moscone Center, Community Lounge (Level 2 West)

Join us for lunch and learn about how implicit bias affects us in both personally and professionally.

PRESENTER
Dr. Alexis J. Stokes

The Great Career Showdown! An Exploration of Careers in Optics and Photonics

31 January 2023 • 3:00 PM–4:00 PM
Moscone Center, Community Stage (Level 2 West)

Join us for this Jeopardy!-style showdown to ask questions of panelists of diverse career stages. Learn about their career-path choices using a fun and interactive gameshow format. Free snacks and drinks after! Sponsored by the **SPIE Career Lab.**

HOST: **Dr. Jessica Wade,** Research Fellow at Imperial College

CONTESTANTS:

Icel Sukovaty, Undergraduate Research Assistant at University of Rochester
Cory Boone, Technical Marketing Manager at Edmund Optics
Dr. Nishant Mohan, Vice President of Product at Notal Vision
Dr. Jennifer Barton, Professor and Director of the BIO5 Institute at The University of Arizona, 2023 SPIE President Elect

If you are planning to attend a meeting and need dependent care, consider applying for an SPIE Family Care Grant. Refer to the table below for individual event deadlines.

Beaded privilege

BEADED PRIVILEGE ACTIVITY

Created by Dr. Kelly Meier and the Kinect Education Group

OBJECTIVES

1. Explore the concept of privilege around various identities from other people's perspectives.
2. Not meant to make anyone feel guilty or ashamed about having or not having a particular privilege.
3. Not meant to capture all identities or the privileges and challenges that come with those identities.
4. Is meant to visually demonstrate the complexities of identities, status, and privilege.
5. To understand that having certain privileges may hinder one's ability to recognize it in the context of larger society, while also making it harder to recognize the struggles of people without those privileges.

INSTRUCTIONS

1. Bead stations set up around the room.
2. Lists of prompts at each bead station.
3. For each prompt:
   a. add a bead to your bracelet if the answer is yes.
   b. Abstain from adding a bead if the answer is no.
   c. Go with your initial feeling if you're unsure.
4. Consider the prompts with respect to the country you currently live in.
5. 55 prompts, up to 55 beads.

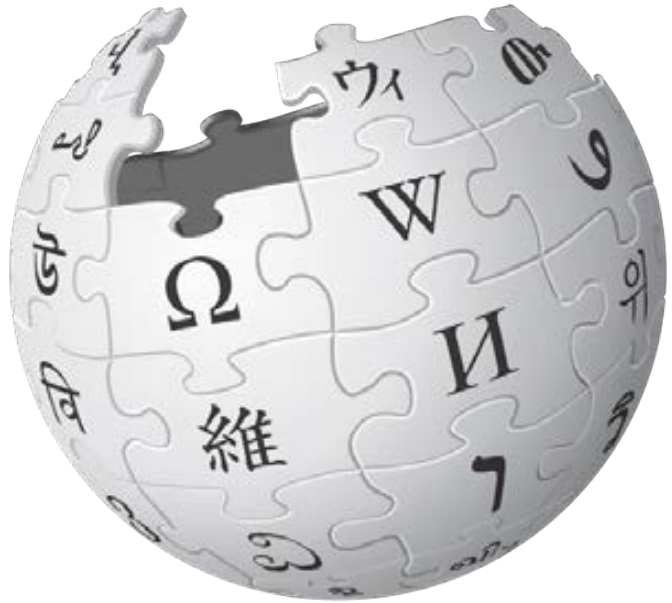
SEXUALITY PRIVILEGE

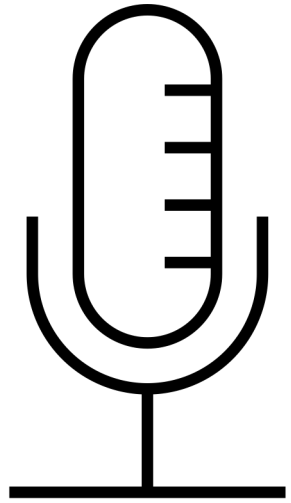
- I have formalized or could formalize my love relationship legally through marriage and receive the benefits that accompany marriage.
- I can move about in public without fear of being harassed or physically attacked because of my sexuality.
- I do not have to fear that if my family or friends find out about my sexual orientation there will be economic, emotional, physical, or psychological consequences.
- If I want to, I can easily find a religious community that will not exclude me for my sexuality.
- No one questions the "normality" of my sexuality or believes my sexuality was "caused" by psychological trauma, sin, or abuse.
- People don't ask why I "chose" my sexual orientation.
- I can go for months without me or anyone else referring explicitly to my sexuality.
- I easily can find sex education literature for

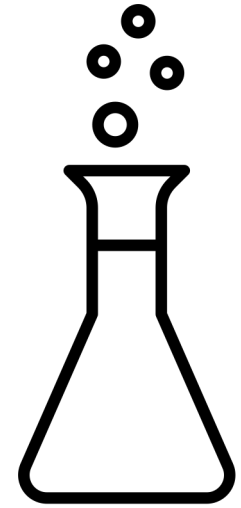
ABILITY PRIVILEGE

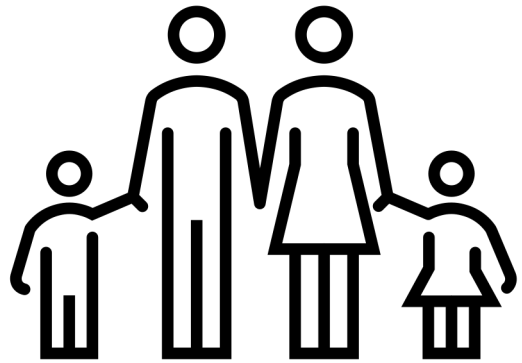
- I can assume that I will easily have physical access to any building.
- I have never been taunted, teased, or socially ostracized due to a disability.
- I can do well in challenging situation without being told what an inspiration I must be to other people of my ability status.
- I can go shopping alone and expect to find appropriate accommodations to make the experience hassle-free.
- I can hear what's going on around me without using an assistive device.
- I can easily see the letters on this page.
- I am reasonably certain that others do not think that my intelligence is lacking, just because of my physical status.
- If I am fired, not given a raise, or not hired, I do not question if it had anything to do with my physical or mental ability.
- People do not judge me based on my personal

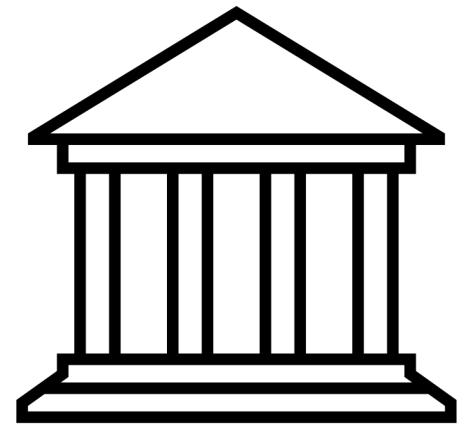
recognition and esteem.











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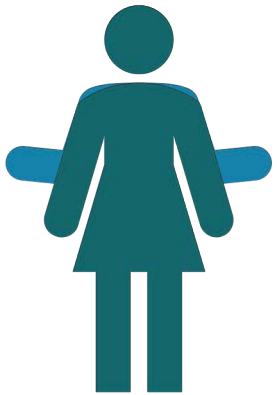
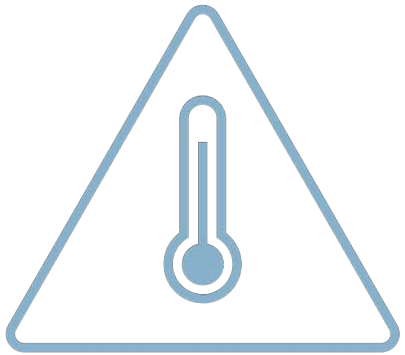
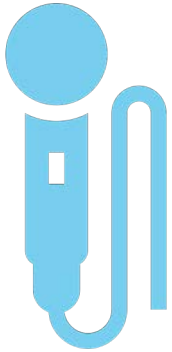


https://humaniki.wmcloud.org


2010

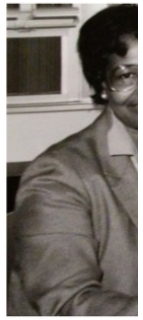
Sarah Gilbert, Oxford

Kizzmekia Corbett, Washington DC

100 Wome
figure' of (

By Amelia Butterly
100 Women

20 May 2018



From the sat nav in
us use global positi

Gladys West is one o
mathematics behind

Until now, her story h

When Mrs West start
state of Virginia in 19
alongside her.

"I carried that load ro
says.

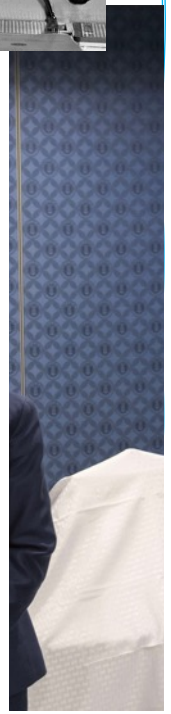
sity

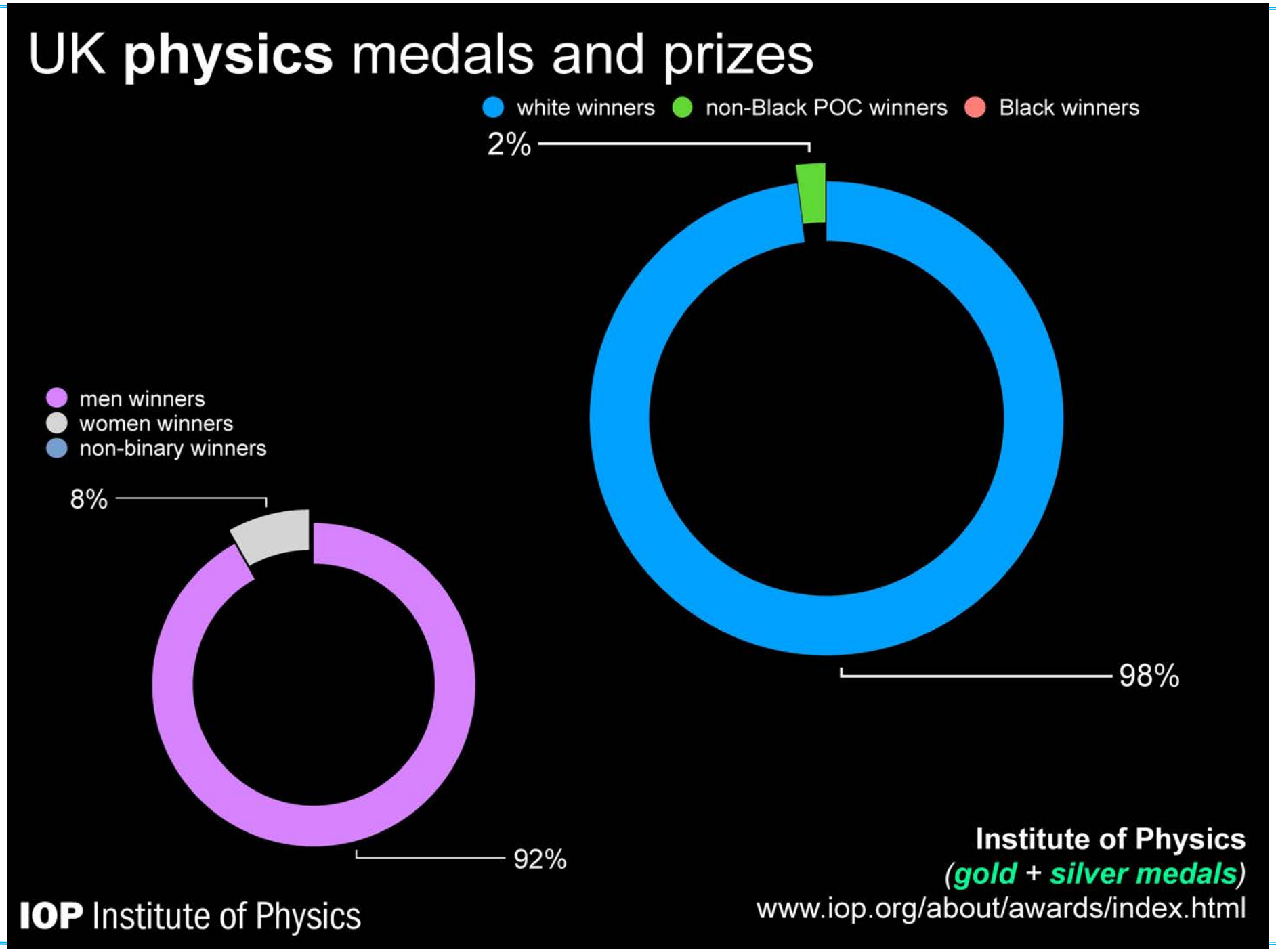
her

Engineering, founded by HRH The
dinburgh, 45 years ago this week
has presented its highest
Prince Philip Medal – to Dr Gladys
ical modelling paved the way for
tion of GPS. Dr West is the first
e Philip Medal in the 30 years
for the first time in 1991 to Air
Whittle, wartime pioneer and
ne.

of complex mathematics and
o process early satellite data to

Dr Gladys West




UK physics medals and prizes
white winners
non-Black POC winners
Black winners
2%
98%
men winners
women winners
non-binary winners
8%
92%
IOP Institute of Physics
Institute of Physics
(gold + silver medals)
www.iop.org/about/awards/index.html

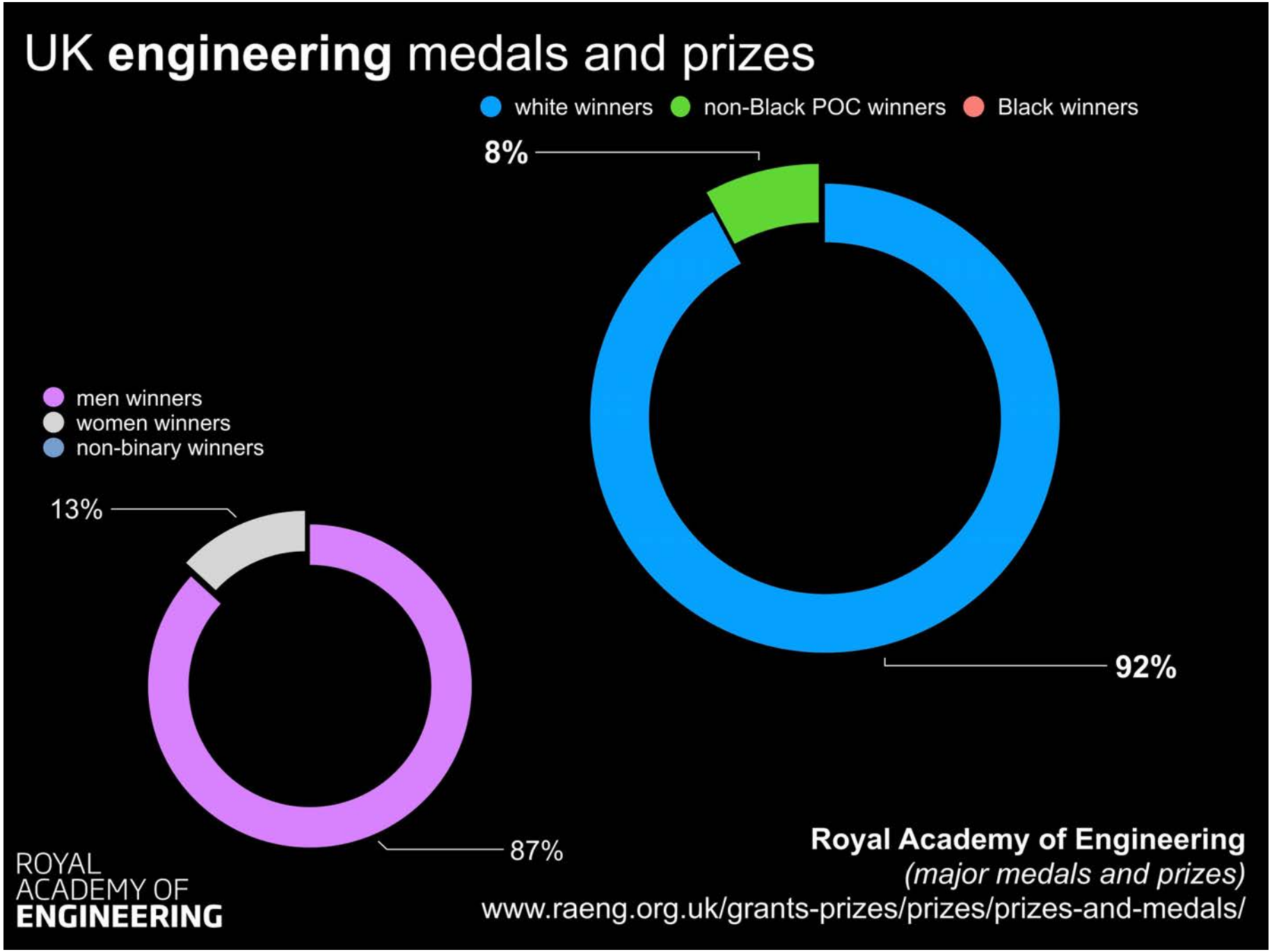
Culture, history and society

2020 William Thomson, Lord Kelvin Medal and Prize

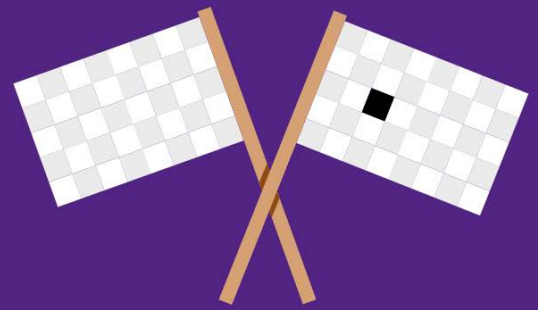
Dr Maggie Aderin-Pocock for exceptional services to science education and physics communication, including her inspirational work with thousands of school students as well as expert opinion on radio and television.

Dr Maggie Aderin-Pocock is an extraordinary science communicator and space scientist, whose sustained commitment to physics engagement has inspired thousands of UK children and adults.

Alongside a successful scientific career spanning academia and industry, from 2006 to 2020 Aderin-Pocock was awarded a Science and Technology Facilities Council Science in Society Fellowship

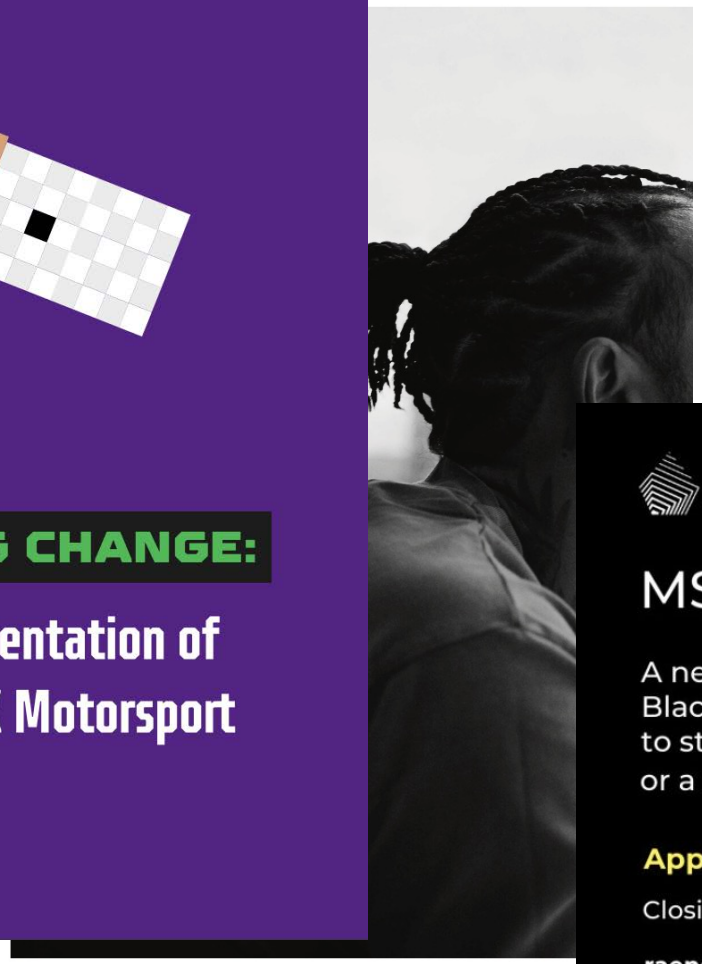

UK engineering medals and prizes
white winners
non-Black POC winners
Black winners
8%
92%
men winners
women winners
non-binary winners
13%
87%
ROYAL ACADEMY OF ENGINEERING
Royal Academy of Engineering
(major medals and prizes)
www.raeng.org.uk/grants-prizes/prizes/prizes-and-medals/

THE HAMILTON COMMISSION



ACCELERATING CHANGE:

Improving Representation of Black People in UK Motorsport



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Lewis Hamilton launches scheme to recruit black teachers in STEM subjects

By Andrew Benson
Chief F1 writer

4 October 2021 | Formula 1

Royal Academy of Engineering

THE IGNITE PARTNERSHIP

MSc Motorsport scholarships

A new programme to support individuals from Black or mixed Black ethnic backgrounds who wish to study a master's degree in motorsport or a related subject.

Training and networking events

Up to £25,000 of funding

Dedicated motorsports experience

Apply now

Closing: **6 March 2023**

raeng.org.uk/msc-motorsport

What can we do?

- Seek c
- Be res
- Use ur
- Make

Goals and Targets

Increased participation in physics from under-represented groups from age 16-19

Girls will make up at least 30% of those taking physics

30%

Double the current number of Black and ethnic minority students will take physics

x2

Double the current number of those from lower socio-economic backgrounds will take physics

x2

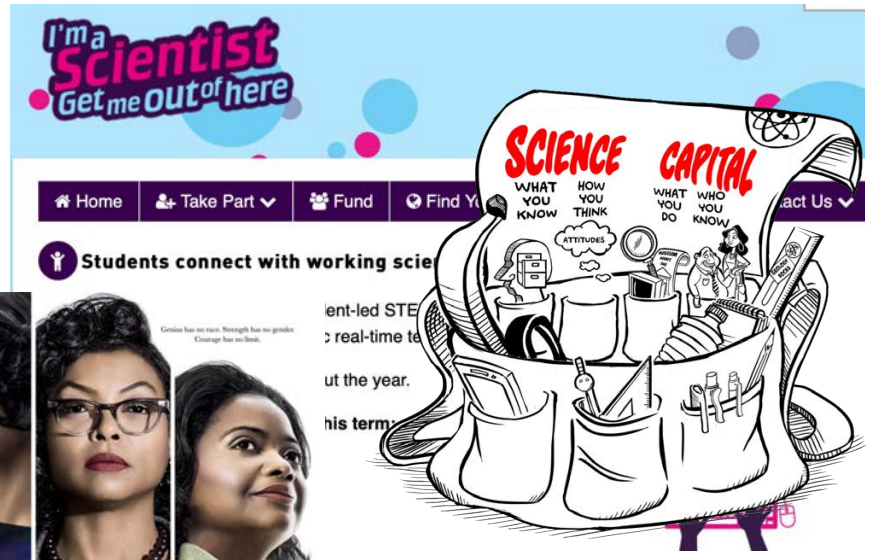
Analysis and action to tackle the root causes of the lack of gender, ethnicity and socio-economic parity in physics study, training and in careers

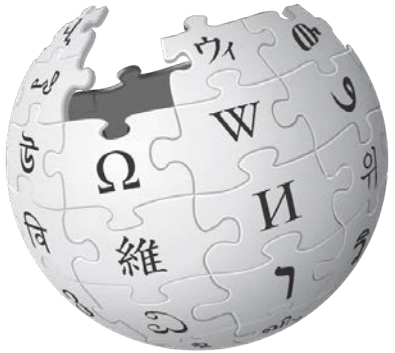
Updating our Accreditation of Physics Degrees to include EDI requirements

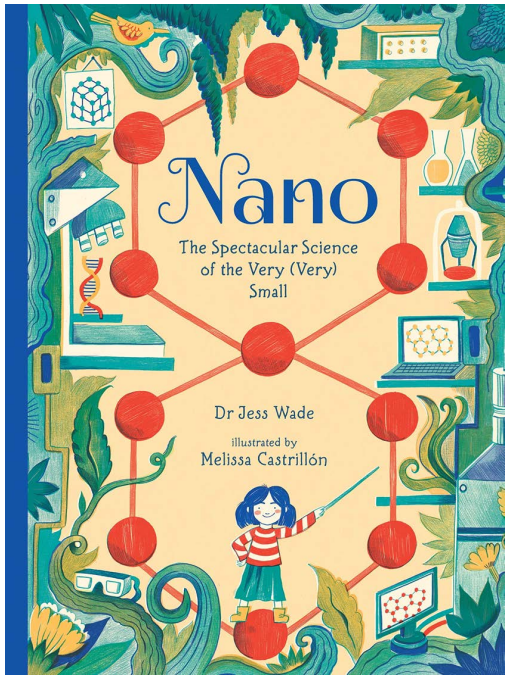
Reviewing our Project Juno award scheme against the challenges and barriers for physicists today and updating this as appropriate

What can we do?

- Improve awareness
- Pro-actively challenge stereotypes
- Level-up: share your privilege and opportunity
- Build networks and communities
- Evidence-based outreach (online, in real life, on radio, on TV…)
- Talk about your research, job opportunities
- Nominate people for prizes and awards

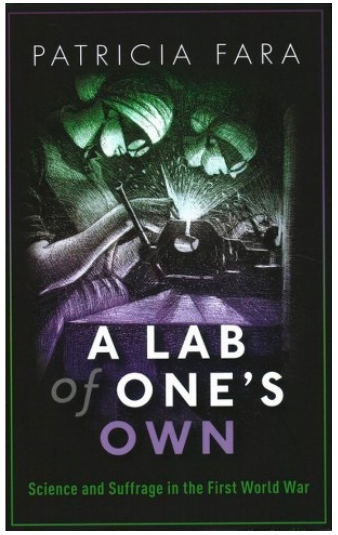


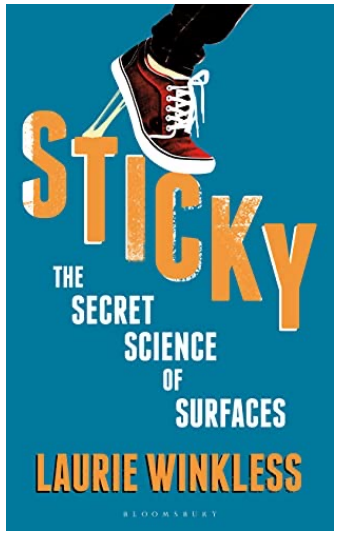


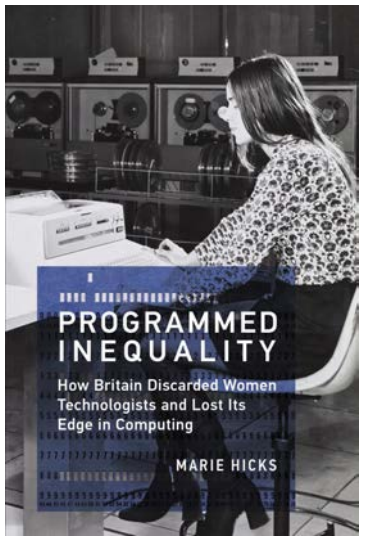



Angela Saini
Inferior
The True Power of Women and the Science that Shows It


CARBON QUEEN
The Remarkable Life of Nanoscience Pioneer Mildred Dresselhaus
Maia Weinstock


PATRICIA FARA
A LAB of ONE'S OWN
Science and Suffrage in the First World War


STICKY
THE SECRET SCIENCE OF SURFACES
LAURIE WINKLESS
BLOOMSBURY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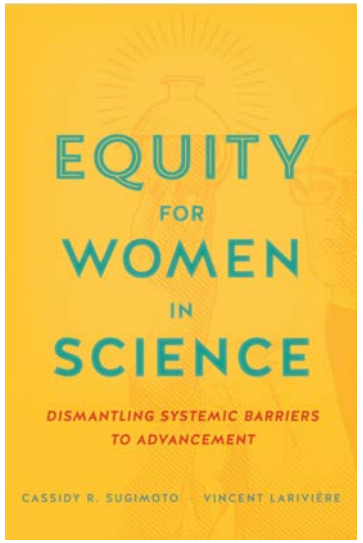
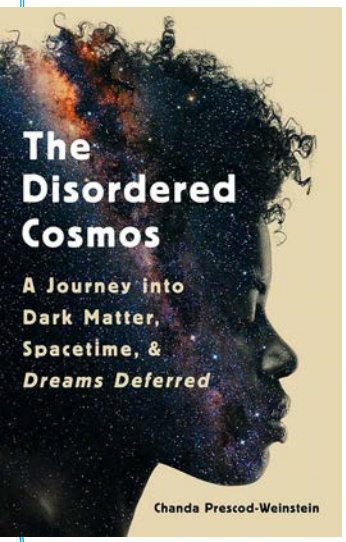
How Britain Discarded Women Technologists and Lost Its Edge in Computing
MARIE HICKS


EQUITY FOR WOMEN IN SCIENCE
DISMANTLING SYSTEMIC BARRIERS TO ADVANCEMENT
CASSIDY R. SUGIMOTO · VINCENT LARIVIÈRE


ANGELA SAINI
THE PATRIARCHS
HOW MEN CAME TO RULE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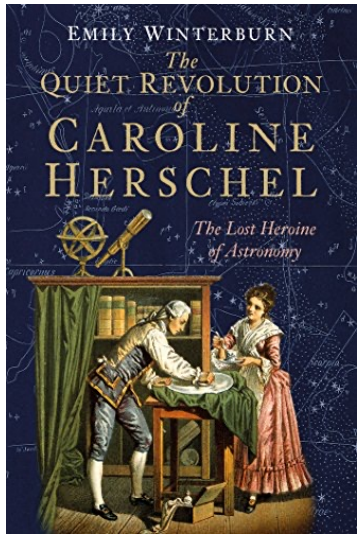
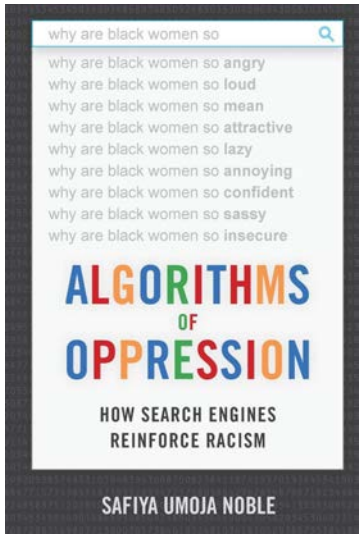
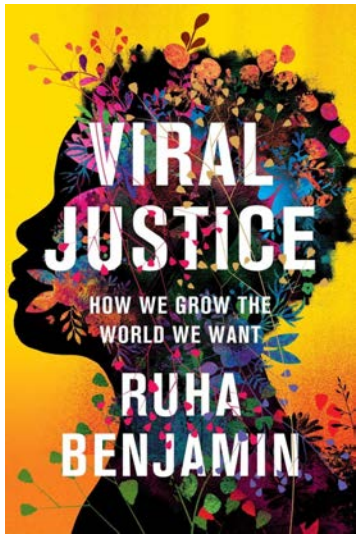
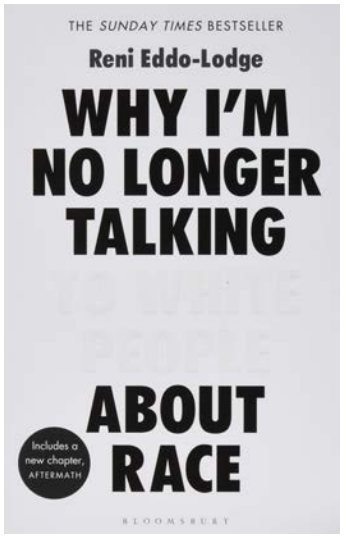
A Journey into Dark Matter, Spacetime, & Dreams Deferred
Chanda Prescod-Weinstein


EMILY WINTERBURN
The Quiet Revolution of CAROLINE HERSCHEL
The Lost Heroine of Astronomy


why are black women so
why are black women so angry
why are black women so loud
why are black women so mean
why are black women so attractive
why are black women so lazy
why are black women so annoying
why are black women so confident
why are black women so sassy
why are black women so insecure
ALGORITHMS OF OPPRESSION
HOW SEARCH ENGINES REINFORCE RACISM
SAFIYA UMOJA NOBLE


VIRAL JUSTICE
HOW WE GROW THE WORLD WE WANT
RUHA BENJAMIN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Reni Eddo-Lodge
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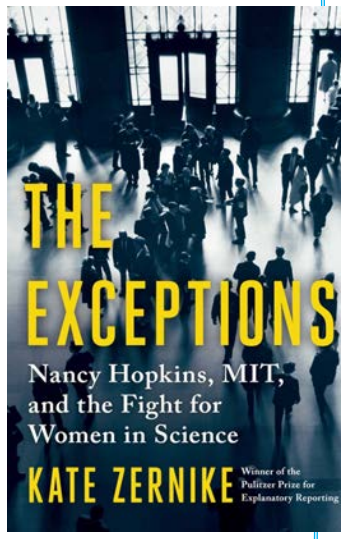
Includes a new chapter, AFTERMATH
BLOOMSBURY


superior
the return of race science
angela saini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KATE ZERNIKE
Winner of the Pulitzer Prize for Explanatory Reporting

thank you

@jesswade
jessica.wade@imperial.ac.uk

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If you used this resource, please take the time to fill out this form to provide your feedback.

If you have any questions or require more information about the REET (Resources for Embedding EDI in Teaching) project, please contact the Project Lead using the following contact details:

Chloe Agg c.agg@imperial.ac.uk