“Limit Less” in Scottish Secondary Schools

Pre-session questionnaire

Heather Earnshaw - Edinburgh Napier University
Martyn Crawshaw - IOP Scotland & Millburn Academy, Inverness

Link to all materials
https://drive.google.com/drive/folders/1-QvU2_DcpmbE68B_-SCZeM5R6qDuWDOW?usp=share_link

IOP Institute of Physics Scotland

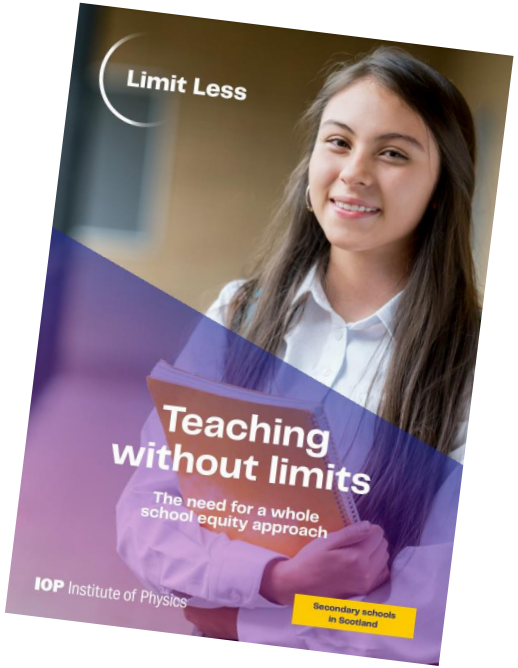
“Limit Less” in Scottish Secondary Schools

Improving equity, diversity & inclusion in physics participation

Which young people are we talking about?

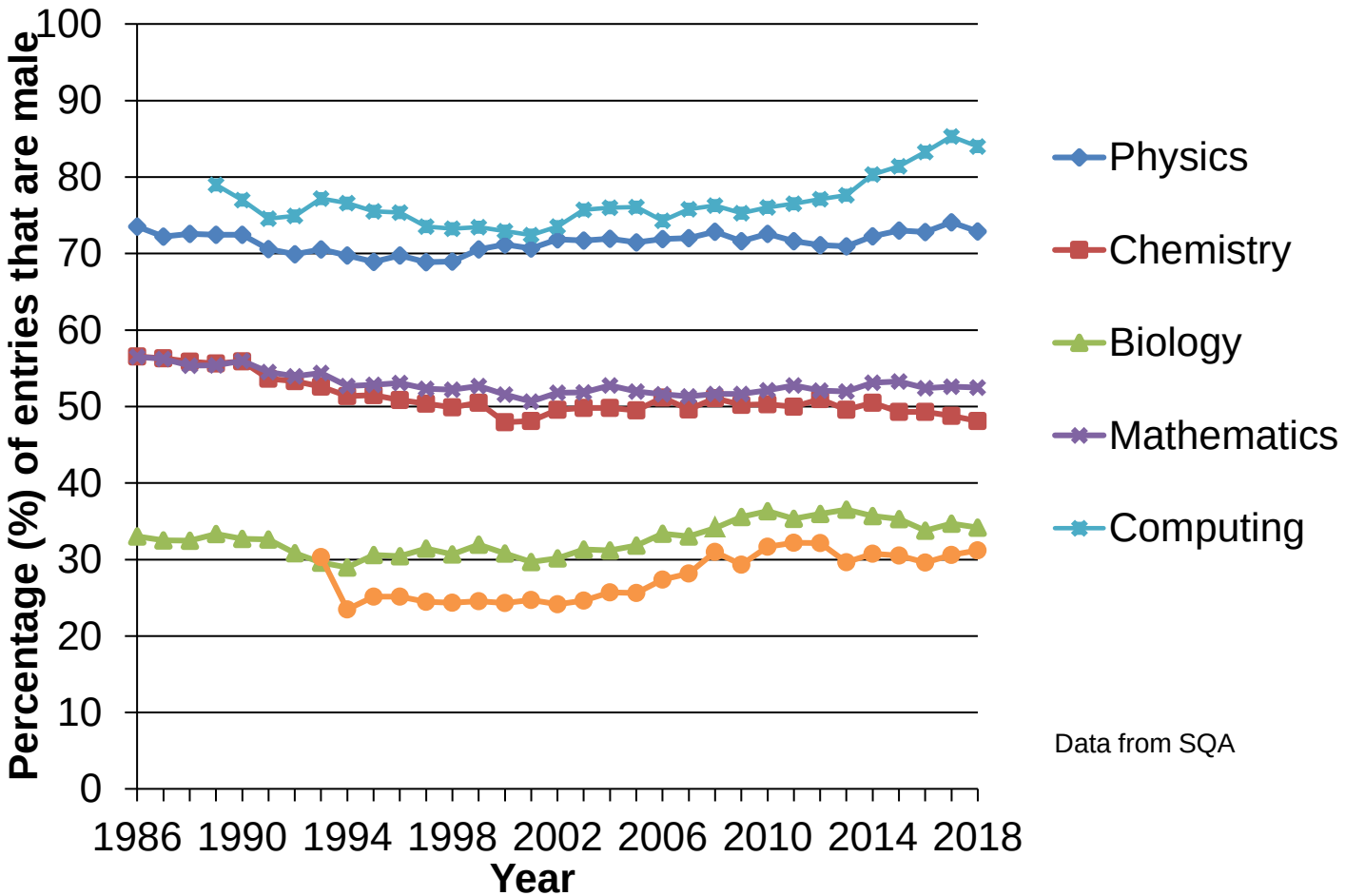
The IOP has identified five groups currently underrepresented or underserved in the physics community:

- Girls
- Young people from disadvantaged backgrounds
- Disabled young people
- LGBT+ young people
- Young people of Black Caribbean descent



IOP - Teaching Without Limits - Secondary - Scotland

Gender balance in uptake of STEM Highers



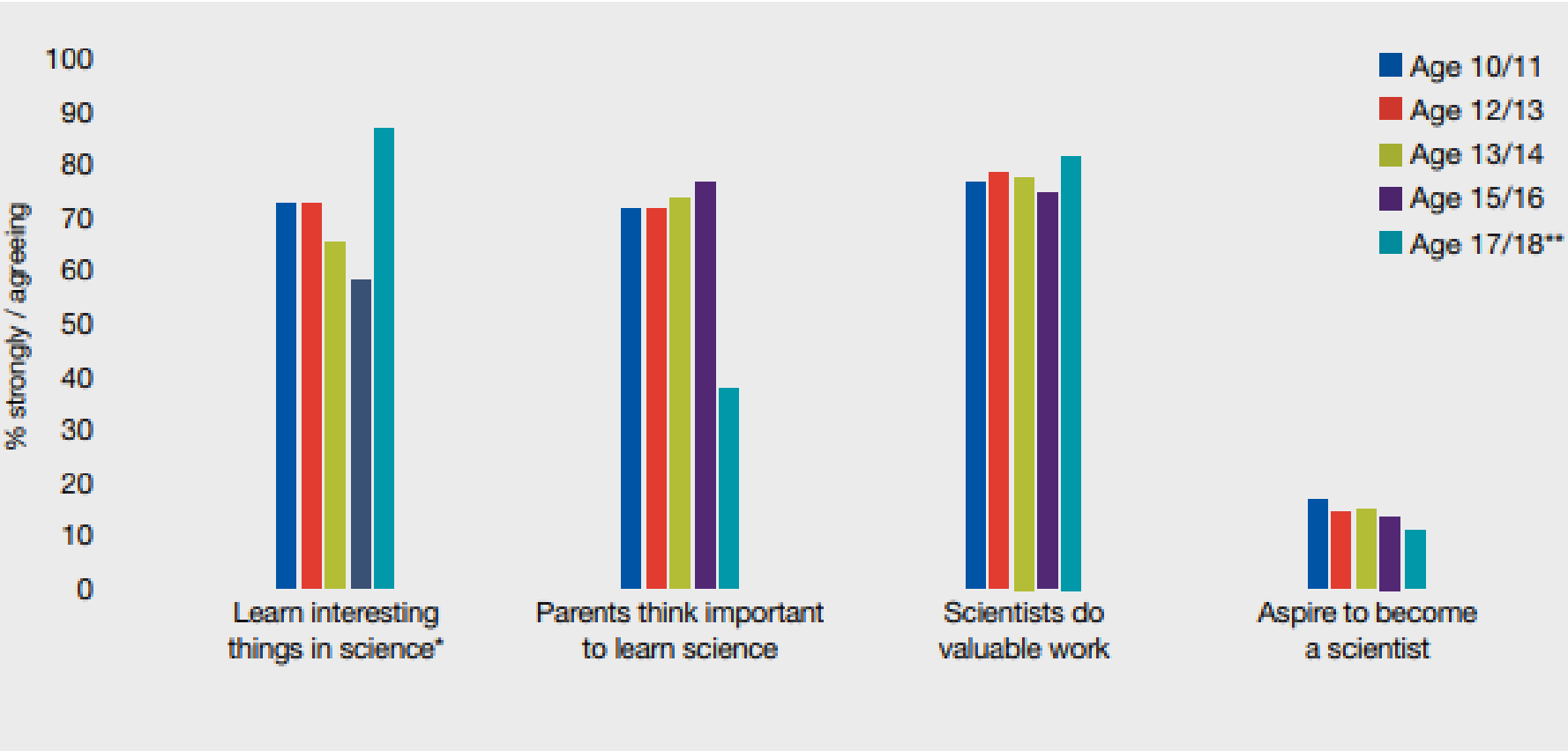
Data from SQA

Some people just aren’t interested in physics

Pupils are free to choose any subject they like

I encourage everyone equally in my classroom

Pre-session questionnaire results



Aspires 2 report

Physics isn’t for me

1. Perception of physics

2. Perception of self

3. (Unconscious) perception others have of me

1. Perception of physics: “masculine and brainy”

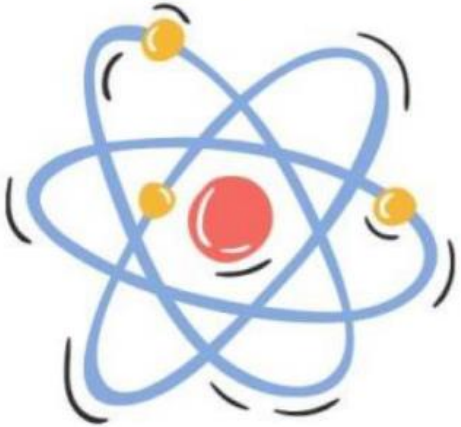
“The pervasive association of science with ‘cleverness’ – an association that made it difficult for many students to continue with the subject.”

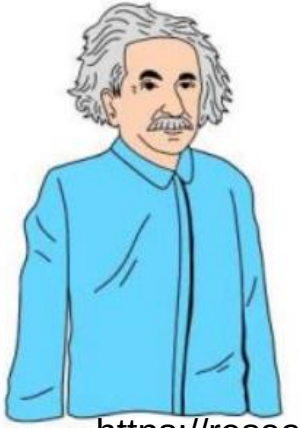
Physics was the area of science that was most strongly seen as being masculine, and it was considered the ‘hardest’.

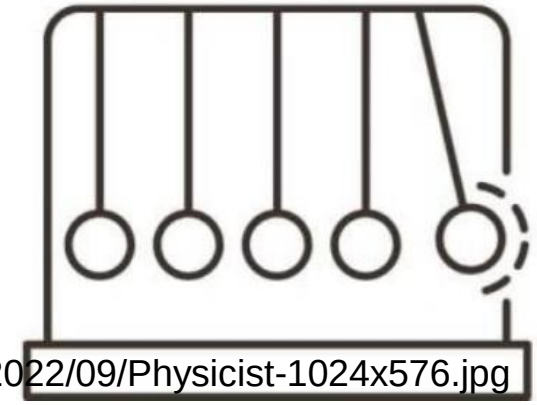
“I wasn’t interested in it because I thought, like, girls didn’t do science or whatever, […] Like from like Year 5 or 6, I was like, I thought like science wasn’t for girls because mostly like boys liked it and like girls didn’t, so I thought that maybe I actually don’t like it because of that” (Celina1, working-class, White British, female, Year 13).

Aspires 2 report

Physicist

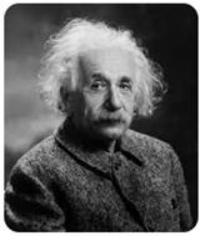






https://researchmethod.net/wp-content/uploads/2022/09/Physicist-1024x576.jpg

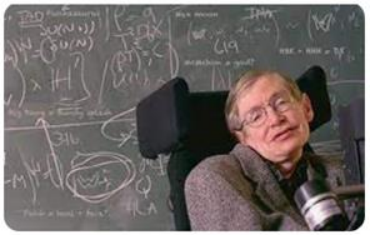
Google physicist



Wikipedia
Physicist - Wikipedia

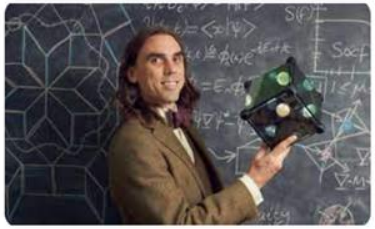
Science | HowStuffWorks
Physicists | HowStuffWorks

The Guardian
Physicist Sabine Hossenfelder:...

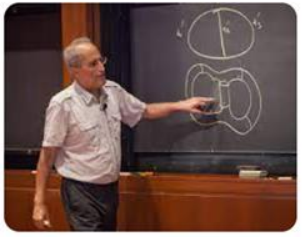


www.chieftain.com
Theoretical physicist Stephen Hawking ...

National Geographic
Freeman Dyson, legendary the...



The Guardian
Physicist Sabine Hossenfelder: 'There ...



Scientific American Blogs
World's Smartest Physicist Thinks ...

Your Free Career Test
What does a Physicist Do, Job ...

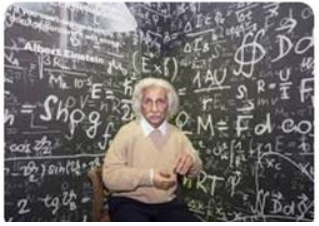
National Institute of ...
Accelerate Change in F...

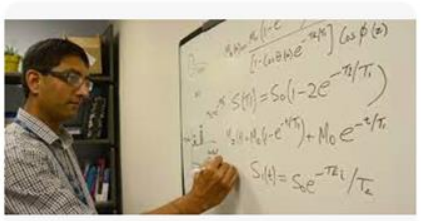
Interesting Engineering
An AI-driven physicist may have ...

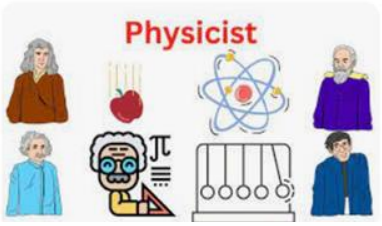
Facebook
Greatest Physicists ...

USC News - Universi...
The Physicist Who Hel...

Business Insider
20 Physicists Who Revolutionized ...







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Google physics student

BMC blog network - BioMed ...
feel studying physics ...

Student Voices - University of York
A day in the life of a Physics student ...

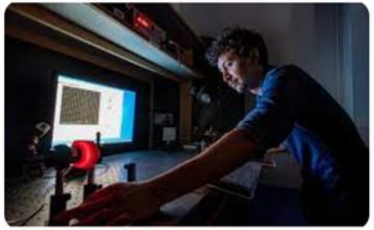
Physics World
girls fancy – Physics World

Wonders of Physics
Movies Every Physics Stud...

Physics tuition
Job Prospects for Physics Students

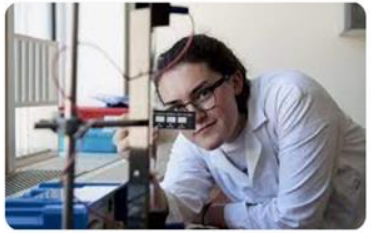
University of York
Student stories - School of Physics ...

Physics tuition
Seven Habits Of Successful Physics Students



University of Southampton
School of Physics and Astronomy ...

Student Research Foundation
Who Are Today's "Physics Fans ...



Richard Huish Trust
Huish students celebrate success in the ...

Cirencester College
Physics A-level – Cirencester College

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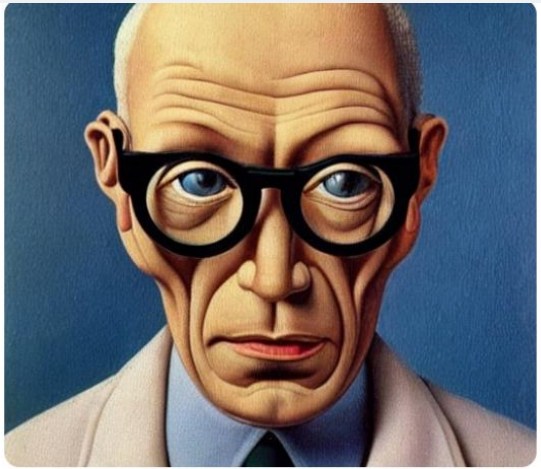
IOP "Bin the Boffin"

Originally used to describe ‘war-winning researchers from World War 2’, the slang term boffin is now generally used to describe any type of scientist, especially one who is doing research.

- 18–24-year-olds are nearly 80% more likely to view the term boffin as an insult than as a compliment.
- 15% of 11–17-year-olds surveyed would be put off studying a subject further, if they were to be called a boffin because of their interest in it.

IOP are specifically calling on the **Daily Mirror**, the **Daily Star** and **The Sun** to stop using boffin in their reporting, due to their large circulation and ongoing use of the word.

BIN THE BOFFIN



https://www.iop.org/sites/default/files/2023-05/Bin-the-Boffin-pamphlet-v2.pdf

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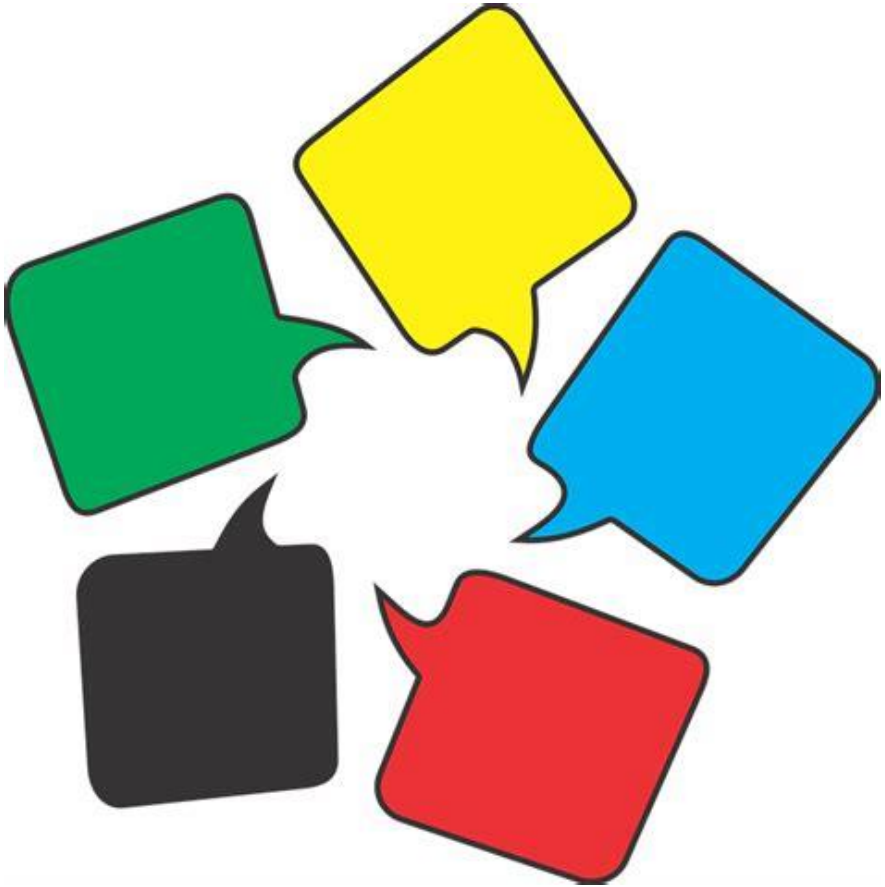
How much do you use images of people in your teaching?



3. (Unconscious) perception others have of me

Impact of unconscious bias

“… they praised girls for their clothing, hairstyles, neatness, and helping behaviors, and in contrast praised boys for their strength, physical skill, size, and academic accomplishments…”

Quoted in Aina & Cameron (2011),
Dimensions of Early Childhood

“One study found that 80% of the observed teachers discouraged preschool girls from using computers by their words and attitudes.”

Quoted in Aina & Cameron (2011),
Dimensions of Early Childhood

“Consistently … from age 10-18, boys were significantly more likely than girls to report that their teacher expected them to do well in science, and to feel that their teacher cared whether they understood science.”

Aspires 2 (2020)

“Despite the encouragement individual students receive from their teachers being a key factor associated with aspirations to continue with physics, girls were statistically significantly less likely to receive such encouragement.”

UPMAP (2013)

“Girls, working-class and minority ethnic students found it hard to be recognised as ‘clever’, and hence as ‘scientists’, regardless of their attainment.”

Aspires 2 (2020)

Which young people are we talking about?

The IOP has identified five groups currently underrepresented or underserved in the physics community:

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- Disabled young people
- LGBT+ young people
- Young people of Black Caribbean descent

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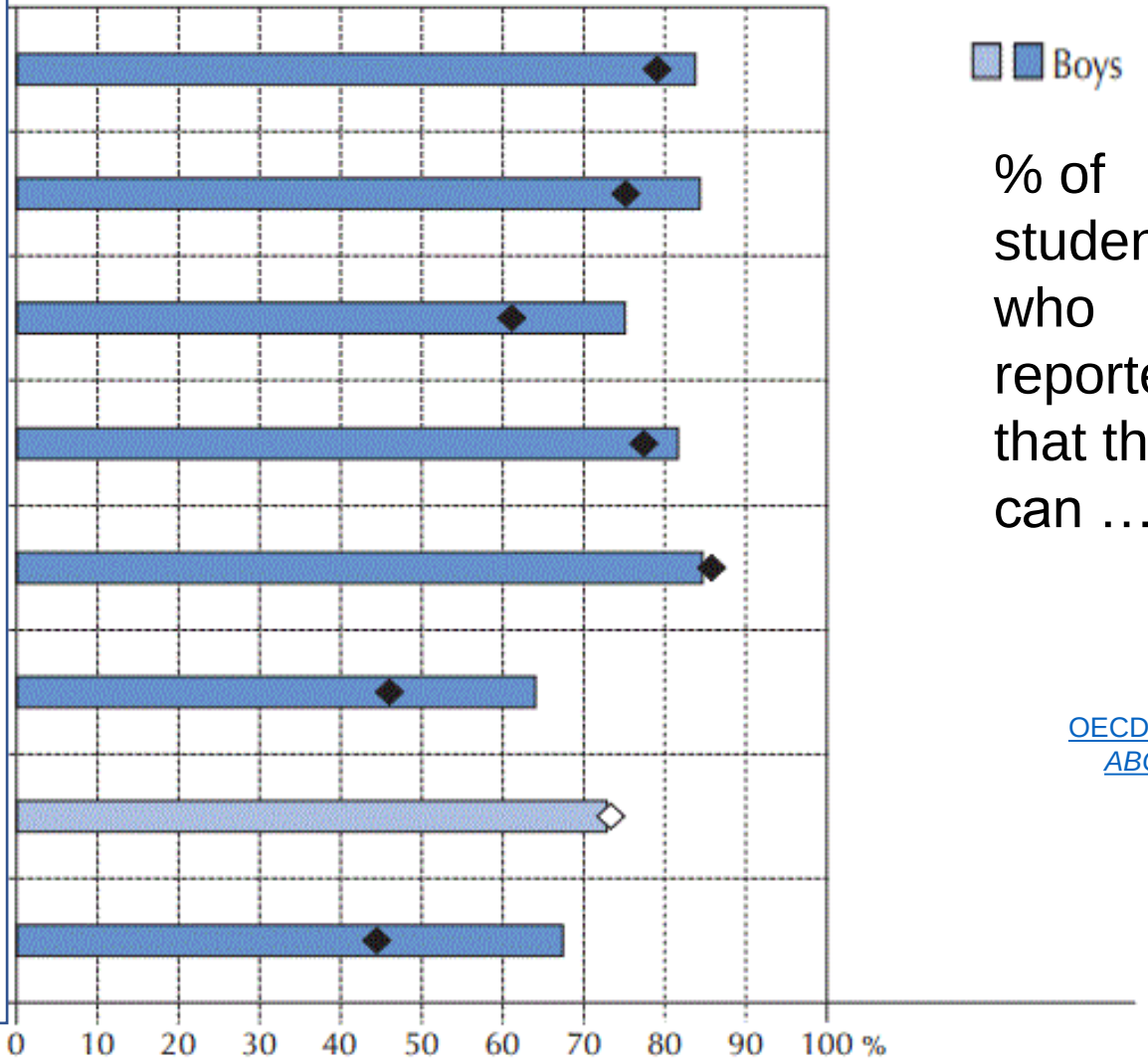
2. Perception of self

2. Perception of self

"Some studies have found that girls rate their own ability as lower than that of boys as early as the first year of primary school – even when their actual performance does not differ from that of boys."

OECD (2015) *The ABC of Gender Equality in Education*



% of students who reported that they can …

OECD (2015) *The ABC of Gender Equality in Education*

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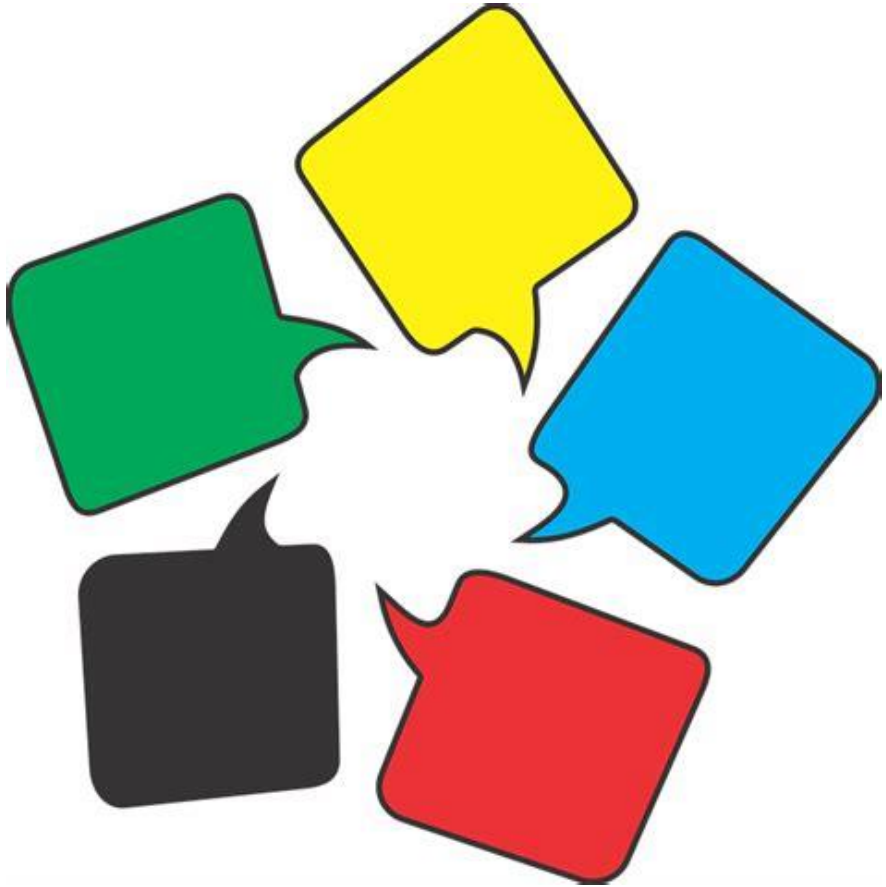
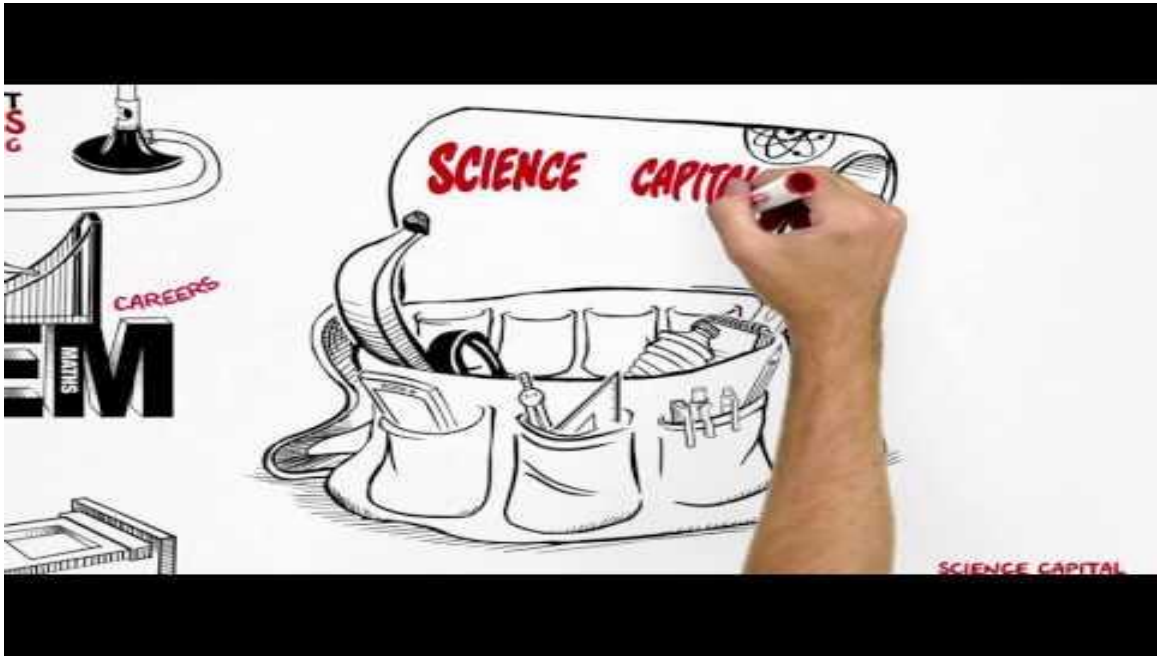
- How have you tried to mitigate unconscious bias?
- How have you tried to build self-efficacy?



Science Capital



Research papers:
https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/stem-participation-social-justice-research/science-capital-teaching-approach

https://www.ase.org.uk/news/what-science-capital-and-what-does-it-look-in-classroom

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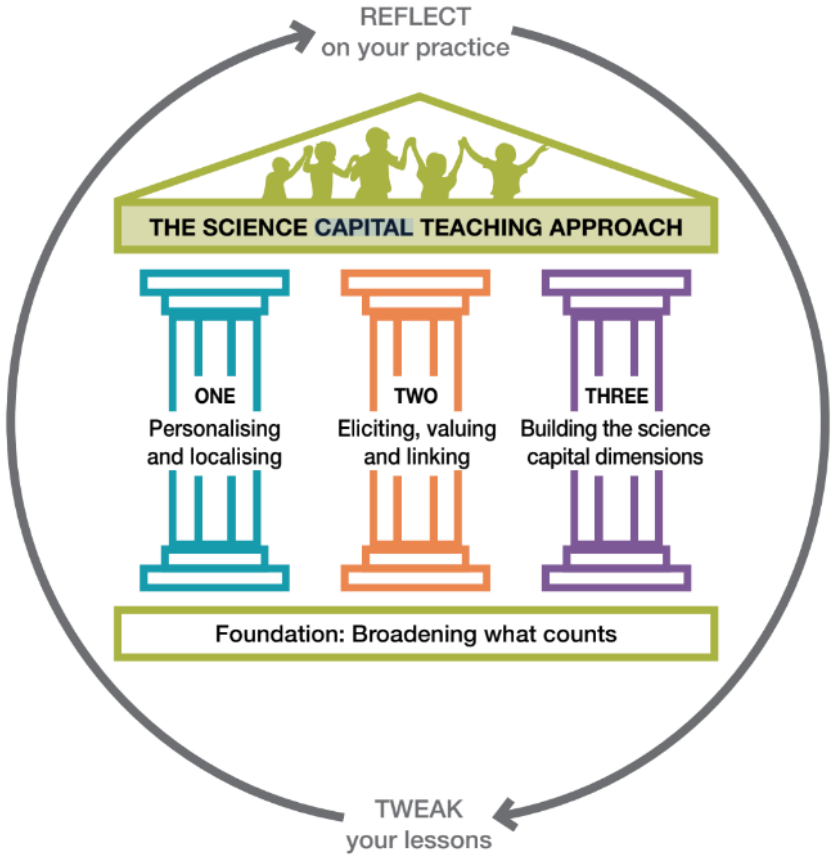
Science capital in action

Foundation: Broadening what counts
Pillar one: Personalising and localising
Pillar two: Eliciting, valuing and linking
Pillar three: Building the science capital dimensions
Tweaking a lesson plan



https://drive.google.com/file/d/14H56kzA3YinETaM2jYohU4N-eDp1NX2A/view?usp=share_link

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Foundation: Broadening what counts

Don't use a context that the kids couldn't care less about - make it personal to them.

Teacher

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PILLAR ONE: Personalising and localising

- Building on their knowledge of
  - students' interests,
  - aspirations,
  - local communities and
  - past experiences.
- Using examples and settings that are familiar and local to students as 'hooks' into the science content.

PILLAR TWO Eliciting, valuing and linking

Teachers elicit, value and link by:

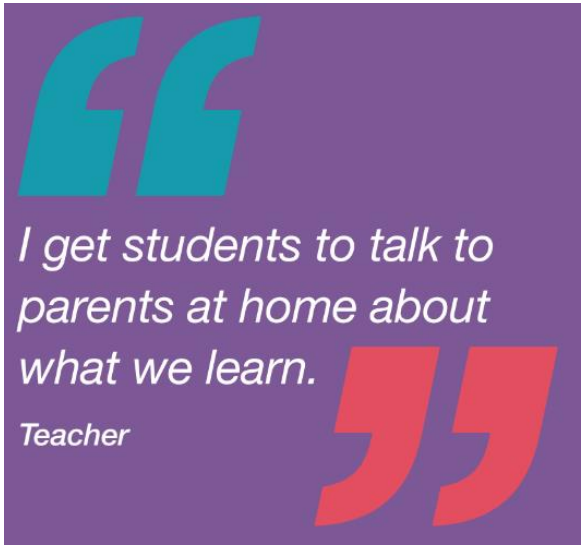
■ Inviting students to think about and **share their own experiences** or ways of understanding.

■ Regularly using **open questions.**

■ Sharing **relevant examples** from their own personal life experiences to help create an environment where all sorts of contributions are valid.

■ Finding ways of **including quiet or shy** students, such as allowing them to work in pairs or small groups prior to talking in front of the whole class, or accepting written contributions.

■ Being prepared to **follow up on a student comment** or question. Comments can be indicative of a student's personal interest, and may also be of relevance to others in the class.



PILLAR THREE: Building the science capital dimensions

Teachers build the science capital dimensions by:

1. Scientific **literacy**
2. Science-related **attitudes**, values and dispositions
3. Knowledge about the **transferability** of science
4. Science **media** consumption
5. Participation in **out-of school** science learning contexts
6. **Family** science skills, knowledge and qualifications
7. Knowing **people** in science-related roles
8. Talking about science in **everyday life**

> *"I make sure that I am aware of any good documentaries that are on TV. I find that even if just one student watches it, it is a win."*
> *Teacher*

> *"I try to find and advertise things that are going on and are science-related. I get flyers for events that students can take home."*
> *Teacher*

‘Tweaked’ lesson plan

> *The more I use the science capital approach ... the easier it is to plan and keep on track.*
>
> *Teacher*

Teacher Activity	Student Activity	
Students (individually, or in pairs) make sounds any way they like. They could choose to play an instrument (if some are available), sing, clap, beatbox, hum, drum, stamp etc.	**The lesson begins with students’ varied cultural experiences and preferences for music-making being welcomed and valued.**	*BROADENING WHAT COUNTS*
Build on students’ contributions and show varied examples on YouTube of cultural music making.		
Ask what all these forms have in common? Ask students to share their ideas about how sound is produced.	In their own words, they discuss what causes sound, and how they can hear it.	
Invite students to draw diagrams on mini-whiteboards to explain how sound is produced, using their own examples and ideas if they can. Value a variety of responses, and link their descriptions to the scientific terms of particles, vibration etc.		*ELICITING, VALUING AND LINKING*
Give students a conundrum that will **appeal to their particular interests (or let them choose).** For example: “Can you remember if you can hear when underwater?” or “In movies set in space, you often hear spaceships ‘zoom’ away – why is this wrong?”		*PERSONALISING AND LOCALISING*
	Students recognise the value of science for explaining everyday phenomena.	*BUILDING THE SCIENCE CAPITAL DIMENSIONS*

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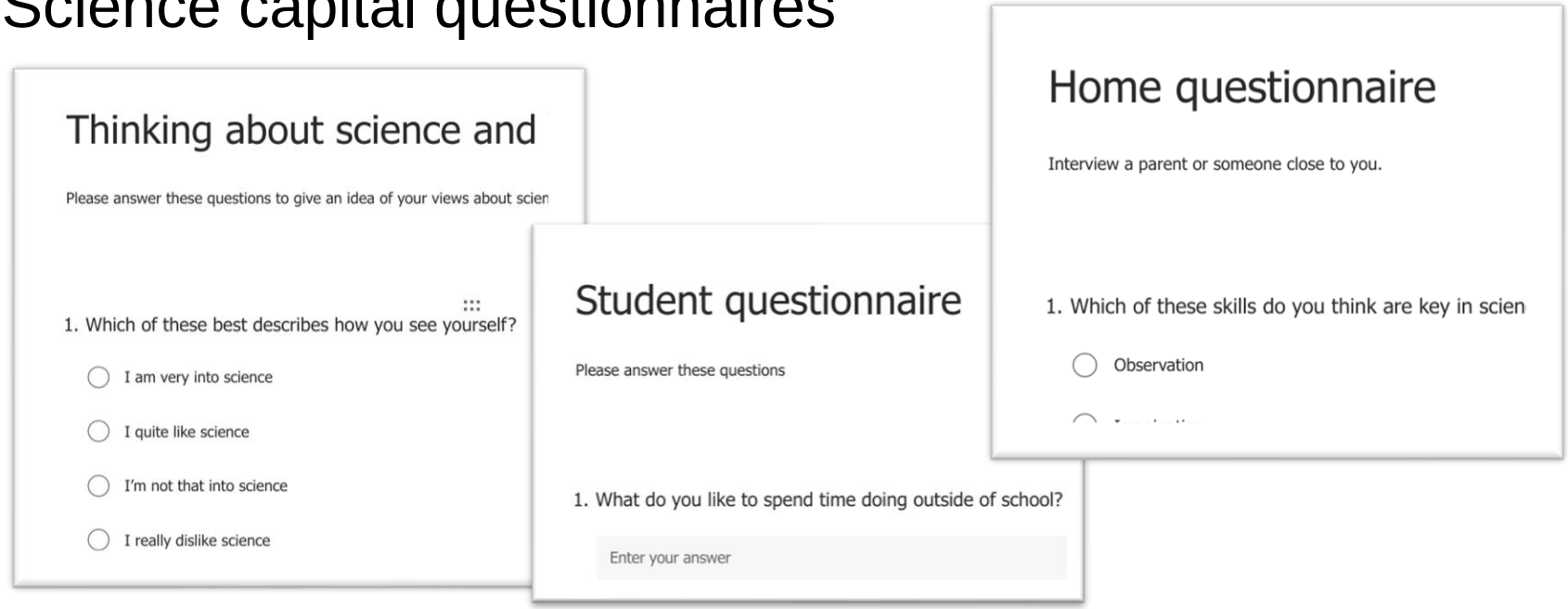
Action-based research?
Science capital questionnaires



https://forms.office.com/e/4cTY4vL3Cb

https://forms.office.com/e/dUeYMxYCSp

https://forms.office.com/e/3DZ2NbhxqY

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Using digital learning to promote Science Capital

- More use of relevant images in teaching
- Use of “people” in images of applications
- Video calls to professionals
- LinkedIn display of former students
- Use of online forms to develop and discuss opinions about science

Use of images

- Before and after...

2. A cyclist leaves the top of a drop travelling horizontally at 6 ms^{-1} and reaches the ground 0.4 s later. Air resistance can be ignored.
(a) What happens to the cyclist's horizontal speed during the drop?
(b) What happens to the cyclist's vertical speed during the drop?
(c) Calculate how far from point X the cyclist lands.

3. A darts player throws a dart horizontally at the centre of the inner bull. The dart leaves the player's hand at a distance of 2.16 m from the dart board and with a horizontal speed of 12.0 ms^{-1} .
(a) Calculate the time taken for the dart to travel from the hand to the board.
(b) Explain why the dart follows a curved path in its flight to the board.
(c) The average vertical speed of the dart during its flight to the board is 0.9 m/s. How far below the centre of the inner bull does the dart hit the board?

2. A cyclist leaves the top of a drop travelling horizontally at 6 ms^{-1} and reaches the ground 0.4 s later. Air resistance can be ignored.

https://www.bicycling.com/training/a20016906/steve-peats-tips-for-mastering-drop-offs/

(a) Describe what happens to the cyclist's horizontal speed during the drop.

(b) Describe what happens to the cyclist's vertical speed during the drop

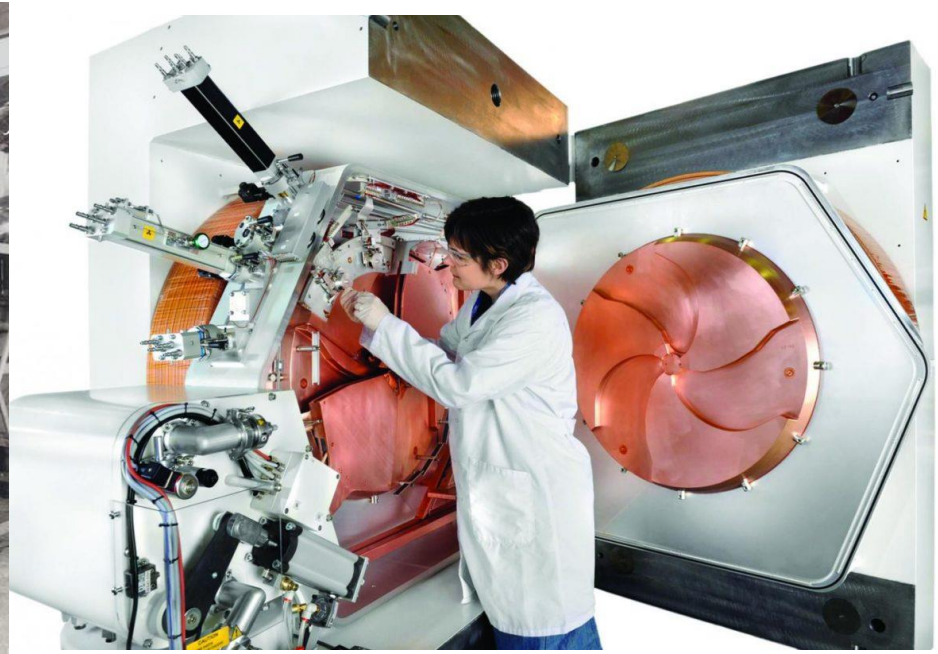
(c) Calculate how far from point X the cyclist lands.

3. A darts player throws a dart horizontally at the centre of the inner bull. The dart leaves the player's hand at a distance of 2.16 m from the dart board and with a horizontal speed of 12.0 ms^{-1} .

https://news.sky.com/story/female-darts-player-fallon-sherrock-beats-another-man-at-world-championships-11892897

(a) Calculate the time taken for the dart to travel from the hand to the board.
(b) Explain why the dart follows a curved path in its flight to the board.
(c) The average vertical speed of the dart during its flight to the board is 0.9 ms^{-1}. How far

People using physics – e.g. "cyclotron"



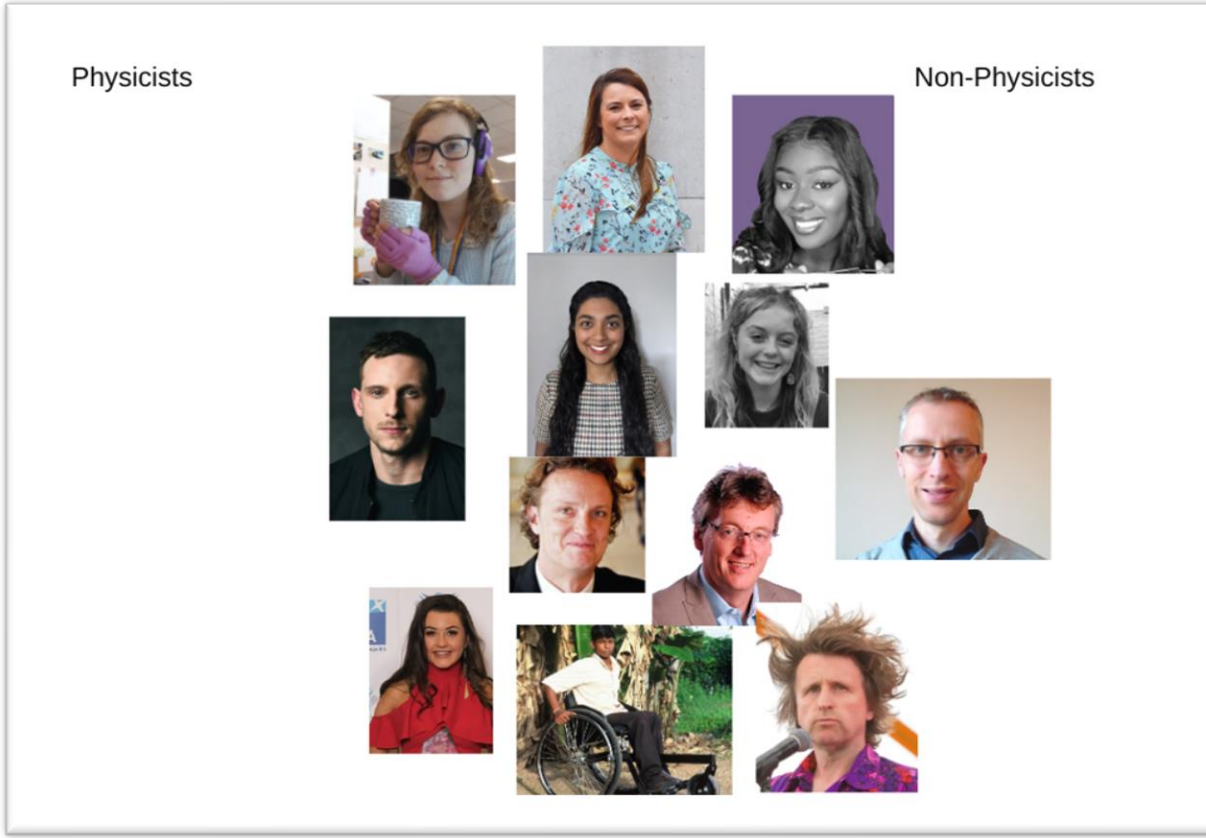
http://scihi.org/ernest-lawrence-cyclotron/

https://www.ge.com/news/reports/02-12-2013meet-the-cyclotron-a-machine-that-shines-a-light-on-cancer

"Spot the Physicist" card sort

Sort the photos into two groups -

- Those who mostly use physics in their job or who have studied a Physics related subject.
- Those who have careers based on other school subjects



https://docs.google.com/presentation/d/1iWtUvhG4_OEn2pClKY6xzTAx-BbX4RMVrwk2u0frOrw/edit?usp=sharing

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Milton Hywel Jones - Comedian

Milton Hywel Jone
humour is based c
in a deadpan and
various shows on
panellist on Mock

https://www.th
2019/aug/02/i
hings
https://en.wiki
Jones

Daisy Shearer

I'm a postg
University c
at the mom
researcher
doctoral res
semicondu
devices) ar
property ca
I'm primaril
with lots of
uncommon

https://www.perfectlyautistic.co.uk/blog/autism-spotlight-daisy-shearer

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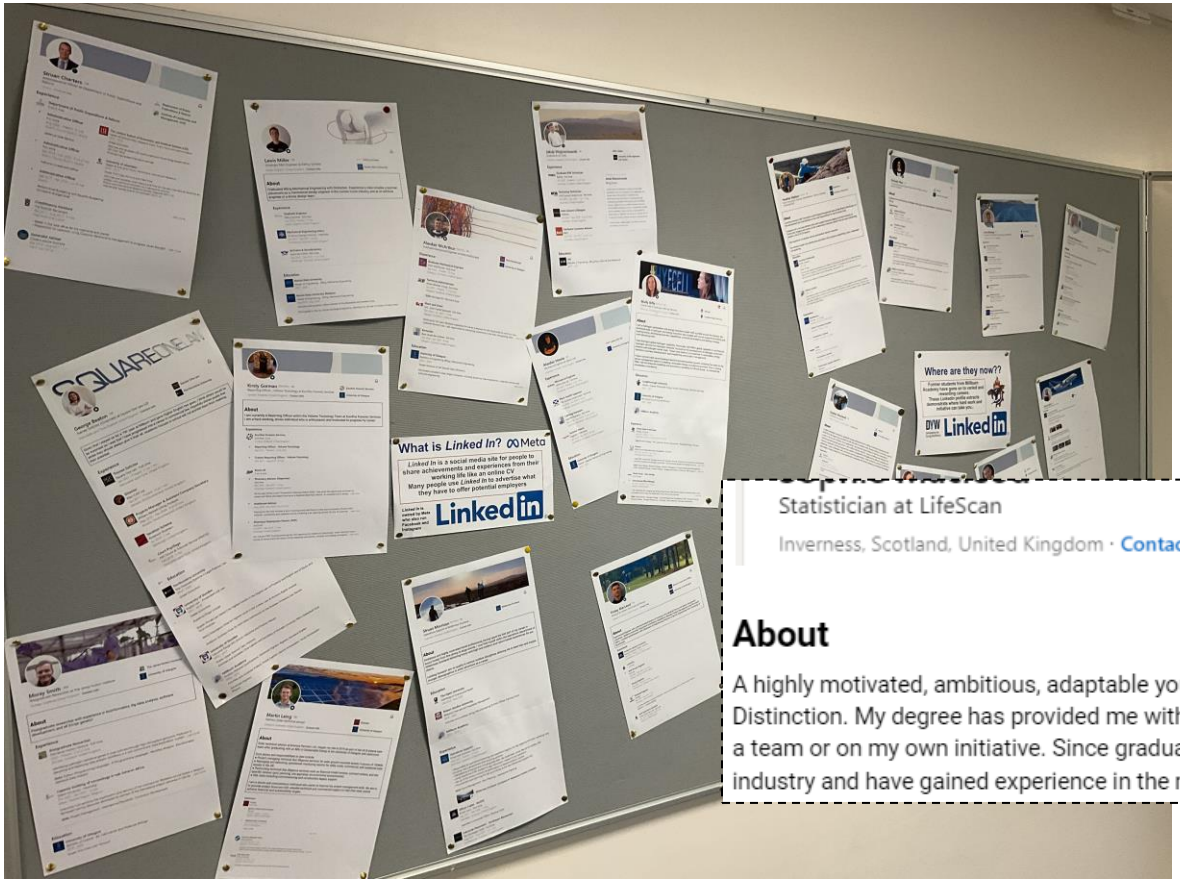
Video call with "real" physicists or professionals

https://www.rhosdduschool.co.uk/class-i-robinwood-teams-call/
https://www.microsoft.com/en-us/microsoft-365/blog/2022/10/12/introducing-microsoft-teams-premium-the-better-way-to-meet/

Showcase a range of former pupils



LifeScan
Full-time · 7 yrs 3 mos
Inverness, Scotland, United Kin

Blade Set Technician
Apr 2017 - Present · 6 yrs

• Repair and maintenance of th
issue diagnosis and repair (Mis

Operations Technician
Jan 2016 - Apr 2017 · 1 yr 4 mo

• Manufacturing of Verio Test S
• Maintaining Verio Manufactu

Statistician at LifeScan
Inverness, Scotland, United Kingdom · Contact info

Heriot-Watt University

About

A highly motivated, ambitious, adaptable young professional with a MEng Architectural Engineering with Distinction. My degree has provided me with the skills to problem solve, develop solutions and work as part of a team or on my own initiative. Since graduating I have pursued opportunities out with the construction industry and have gained experience in the medical devices industry. I enjoy a challenge and branched into

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Limit Less resources for educators

These resources are for educators and schools to champion inclusive teaching and remove barriers that exist for too many young people in education.

You can also learn about our growing number of Limit Less **partnerships** and back the **manifesto for change**.

Education

- How to become a physics teacher
- Retaining physics teachers
- School data dashboard
- Teacher training scholarships
- Teaching physics in school and college
- Teaching physics in higher education
- University students
- School and college students
- Support for ITE providers
- Sign up to our community of physics teaching
- Grants and Awards
- Dismantling barriers to inclusion in physics
- Limit Less resources for educators

Top Tips for Inclusive Science Teaching

This booklet is to support you with practical ways to make your teaching, interactions and classroom as inclusive as possible. You will find nine guiding principles for inclusive teaching, arranged under the three themes of:

- Creating an inclusive culture;
- Making the learning relevant; and
- Building literacy and numeracy for science.

Download the booklet (PDF, 1.68MB) >

For more on the research behind the tips, quick wins and supportive conversations on inclusive teaching, head to the dedicated **Talk Physics group**.

Inclusive Science Teaching poster

How can we make sure that all students feel included and that they have what they need to thrive? This poster is a handy overview of the *Top Tips for Inclusive Science Teaching*.

Download the poster (PDF, 730KB) >

Action guides

These action guides give ideas for tackling gender balance on a personal level, within the classroom and for the whole school:

Introduction (PDF, 576KB) >

Early learning and childcare centres (PDF, 700KB) >

Primary schools (PDF, 328KB) >

Secondary schools (PDF, 320KB) >

Back to top >

Case studies

These case studies describe actions developed by practitioners from early years to secondary.

Download (PDF, 1.5MB) >

Back to top >

Posters and postcards for raising awareness around school

Posters (PDF, 7.75MB) >

Postcards (PDF, 3.51MB) >

Back to top >

Classroom interactions template

This template gives a framework for monitoring interactions with female and male students in the classroom.

https://www.iop.org/education/dismantling-barriers-to-inclusion-physics/inclusive-resources

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IOP Limit Less Top tips for teachers

Create an inclusive classroom culture

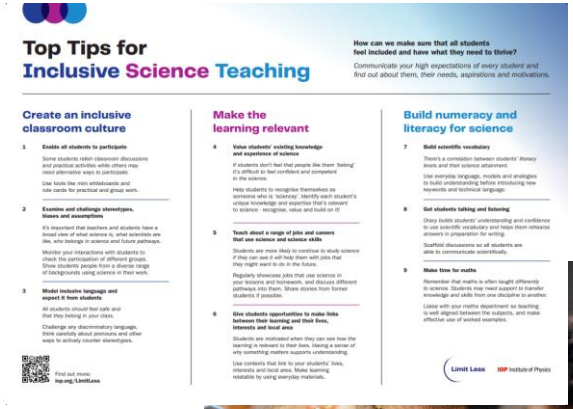
1. Enable all students to participate
2. Examine and challenge stereotypes, biases and assumptions
3. Model inclusive language and expect it from students

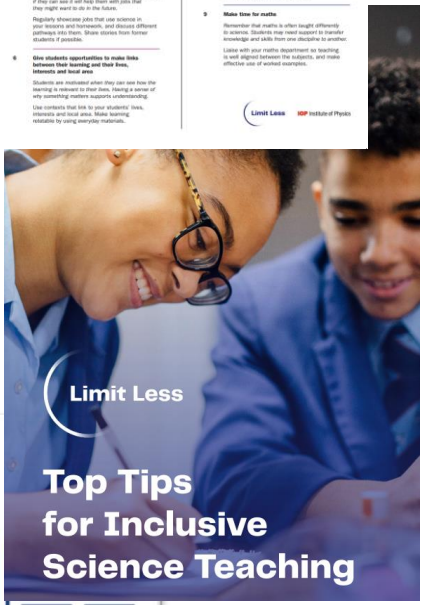
Make the learning relevant

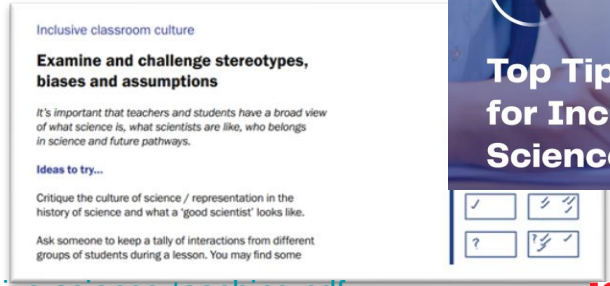
4. Value students' existing knowledge and experience of science
5. Teach about a range of jobs and careers that use science and science skills
6. Give students opportunities to make links between their learning and their lives, interests and local area

Build numeracy and literacy for science

7. Build scientific vocabulary
8. Get students talking and listening
9. Make time for maths







https://www.iop.org/sites/default/files/2023-02/iop-top-tips-for-inclusive-science-teaching.pdf
https://www.iop.org/sites/default/files/2023-02/Inclusive-Science-Teaching-Poster.pdf

IOP Institute of Physics
Scotland

Rights respecting schools https://www.unicef.org.uk/rights-respecting-schools/

IOP Institute of Physics Scotland

Example action plan

Strand a: Teaching and learning about rights

The United Nations Convention on the Rights of the Child (CRC) is made known to children, young people and adults who use this shared understanding to work for improved child well-being, school improvement, global justice and sustainable living.

Outcome	At silver	RAG	Actions – WHAT, who, when
1. Children, young people and the wider school community know about and understand the UN Convention on the Rights of the Child and can describe how it impacts on their lives and on the lives of children everywhere.	Many children and young people are familiar with a number of Articles of the CRC and can talk about the rights they enjoy.		-Articles displayed in every classroom. -Feature wall of Articles – Makaton and dyslexia friendly. -Introduce a 'Right of the Week' assembly focus, shared on pupil notices and year head classrooms. Also invite visiting speakers. -Specific Support for Learning (HUB) actions:- • Visiting speaker to talk to pupils about their rights. • Hold a SHANARRI/UNCRC party/launch • Pupils create and deliver presentations to deliver to peers. • Introduce 'Tea with Teachers' to develop relationships.
	Many children and young people know rights are universal and unconditional; the CRC applies to all children and young people everywhere, all the time.		
	Many children and young people demonstrate an awareness of where and why some children may not be able to access their rights.		
	Adults and the wider school community know about and understand the CRC.		

https://campaign.iop.org/page/87075/petition/1?chain

Support young people to change the world

Through the Limit Less campaign, the IOP wants to support young people to change the world and fulfil their potential by doing physics.

Please sign up to the manifesto today so that we can show our politicians that there is widespread support for improving equity and incl the education sector.

Not an educator? Please sign up here **instead**.

The manifesto - the IOP is calling on the governments of the UK and Ireland to:

1. Revise professional standards for teachers to set out an expectation that teachers will address injustice in their professional practi actively dismantle any sexism, racism, homophobia, ableism and classism from their own work and their schools.

Plan

11:00 Pre-session questionnaire results – Martyn
11:05 "Do we have an issue here?" - Heather
Everyday images of physicists
11:20 Science Capital – Martyn
11:30 Strategies and suggestions – Martyn

QR codes for "Limit Less" at Stirling 25/5/23

Pre-session questionnaire

Spot the physicist slides

IOP Limit Less

Science capital questionnaires