

Diversifying the STEM Curriculum

Queen Mary University of London
School of Mathematical Sciences
School of Engineering and Material Science

The importance of representation

55 Nergis Mavalvala

General Relativity; Data Analysis

Keywords: Women, Queer, Pakistani

Nergis Mavalvala (1968-) is a Pakistani physicist known for her leading work in the discovery of gravitational waves. Her Ph.D. work solved the problem of how to precisely align mirrors less than a metre wide separated by four kilometres, and this method is implemented today in LIGO to detect gravitational waves. She began working in the field well before most people had heard of gravitational waves, and her work has been an integral part of an international collaboration of thousands of scientists.



In 2014, Mavalvala and her group were working on the quantum technologies being implemented in the Advanced LIGO system. When the new system came online, the group needed to validate the data analysis techniques of the new system by feeding fake signals into the data stream and seeing if these signals were detected. This was important, because the project was able to detect gravitational waves which produced very strong signals compared to the signals from background noise with high statistical significance.

Mavalvala was a recipient of the MacArthur genius award in 2010, was named LGBTQ Scientist of the year in 2014, and in recent years she was appointed Dean of the School of Sciences at MIT. She is also renowned for her advocacy in challenging racial and social injustices in STEM.

See more in [this summary](#) or in [this interview](#).

Diversifying the Maths Curriculum



Queen Mary University of London SCHOOL OF MATHEMATICAL SCIENCES
DIVERSIFYING THE MATHS CURRICULUM
Luis Caffarelli (HE/HIM)

EARLY LIFE
Luis Caffarelli is the first South American winner of the Abel Prize. He was born in the city of Buenos Aires, Argentina. Family was a huge factor in Caffarelli's early life, and would inform his attitudes towards collaboration and community in his later years. To Caffarelli, family and friendship would always be a strong presence in his working life going forward.

"I have truly enjoyed every moment of my mathematical career. My career and collaborations have been a constant source of joy and inspiration"

A NEW DIRECTION
In 1974, the mathematician Hans Lewy delivered a lecture series at the University of Minnesota on nonlinear partial differential equations and free boundary problems. Caffarelli instantly became inspired, and asked Lewy for some extra problems to work on.

OBSTACLE TO SUCCESS
The Obstacle Problem is an example of a free boundary problem. These are equations that model situations for which the boundary of a given medium may change over time, for example, a block of ice melting into water.

ENTERING ACADEMIA
In 1985, he applied for a PhD position at Universidad de Buenos Aires. He was accepted under the tutelage of Carlos Calderin, who played the most crucial role in Caffarelli's development as a mathematician.

In 1972, his thesis on Conjugation and Summability of Jacobi Series was accepted by the university, and he became a Doctor of Mathematics.

"I came to the United States to the University of Illinois in 1970. There were no men, no fax, and the telephone was very expensive. But I found at Illinois and in the vibrant an extraordinary group of people."

AWARDS AND ACCLAIM
The Navier-Stokes breakthrough cemented Caffarelli as one of the great mathematical minds of the modern era, and the awards followed soon thereafter.

- AMS Bôcher Prize (1984)
- International Congress Speaker (2002)
- AMS Steele Prize (2005)
- Wolf Prize (2012)
- AMS Steele Prize (2014)
- Shaw Prize (2018)
- Abel Prize (2022)

ACADEMIC JOURNEY
Mavalvala has awarded a degree in Mathematics from Queen's University of Technology in 1999. It was at Harvard University where she obtained a PhD for contributing in Riemannian surfaces in 2004 under the supervision of Curtis McMullen, who was a winner of the Fields Medalist.

"As a graduate student at Harvard, I had to specify quite to the letter that I was allowed to attend a university as a woman in 1981."

In 2003, she was appointed as Professor of Mathematics at Stanford University. There she met Jan Vondra, a theoretical computer scientist and applied mathematician who would become her husband.

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DIVERSIFYING THE MATHS CURRICULUM
Maryam Mirzakhani (SHE/HER)

EARLY LIFE
Maryam Mirzakhani was an Iranian mathematics genius. She was the first woman to receive the Fields Medal. Born in Tehran, she was raised in a family with an interest in mathematics, as her father was an electrical engineer.

A NEW DESTINY
In 2004 she was offered a junior fellowship at Harvard, but turned down the offer since something better awaited her.

That same year she was awarded a Clay Research Fellowship and was appointed as Assistant Professor of Mathematics at Princeton University.

"I don't think that everyone should become a mathematician, but I do believe that many students don't give mathematics a real chance... I can see that without being excited, mathematics can look pointless and cold."

"The beauty of mathematics only shows itself to more patient"

AWARDS
In 2014, Mirzakhani was awarded the prestigious Fields medal for her outstanding contributions to the dynamics and geometry of Riemann surfaces and their moduli spaces.

"The Clay Fellowship gave me the freedom to think about harder problems, travel freely, and talk to other mathematicians. I am a slow thinker, and have to spend a lot of time before I can open up my ideas and make progress. So I really appreciate that I didn't have to write up my work in a rush."

ACADEMIC JOURNEY
Mirzakhani has awarded a degree in Mathematics from Queen's University of Technology in 1999. It was at Harvard University where she obtained a PhD for contributing in Riemannian surfaces in 2004 under the supervision of Curtis McMullen, who was a winner of the Fields Medalist.

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Nira Chamberlain (SHE/HIM)

THE BEGINNING
Prof Nira Chamberlain OBE, a British-born mathematician of Jamaican heritage, has a renowned international career and is a chartered scientist based in Birmingham.

Nira always had a passion for mathematics throughout his studies. Despite the lack of encouragement from his teachers, who constantly urged him to pursue sports instead of mathematics, Nira received unwavering support from his family. He went on to study a BSc in Mathematics at Coventry Polytechnic (1992), followed by an MSc in Industrial Mathematics (Holding at Loughborough University (1993)).

"Mathematics is indisputably the greatest subject in the world! Why? Because it is the language of the world. Mathematics crosses racial, geographical and cultural boundaries."

EARLY CAREER
While working several positions in industry, he did his part time PhD at Portsmouth University. His reason for pursuing a PhD was "to challenge the stereotype that Blacks are incapable of excelling in mathematics" and serve as a role model.

OUTREACH
Chamberlain founded the annual "Black Heroes of Mathematics" conference, an international event aiming to highlight the talents of black mathematicians funded by the International Centre for Mathematical Sciences.

AWARDS
Nira is the recipient of multiple honours and awards, among which:

- Big Hero O'H - World's Most Interesting Mathematician (2018)
- 5th Most Influential Black Person in the UK, PowerList (2018)
- Top 100 Most Influential Black Leaders in UK Tech Sector (2019)
- Honorary Member of The Mathematical Association (2020)
- Fellow of the African Scientific Institute (2022)
- The First Black of African descent President of The Mathematical Association (2022)

I really enjoyed your talk at **Piform23** the other week!

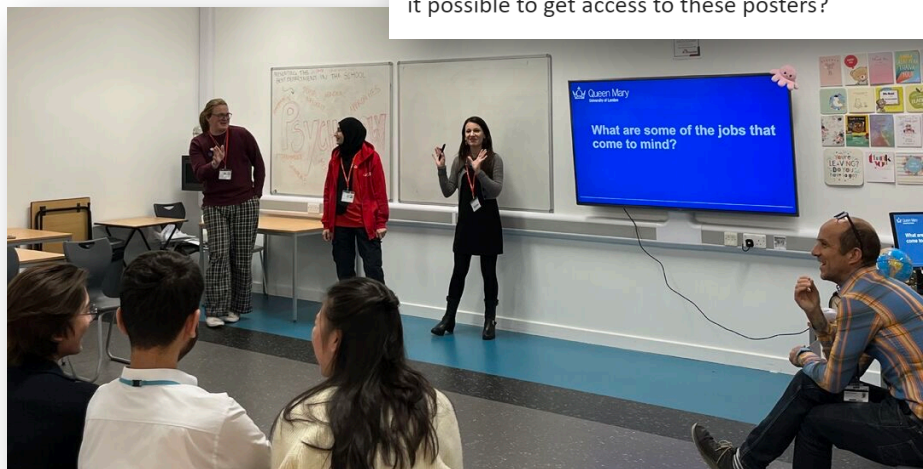
I am on the local committee of Piscopia at the **University of Nottingham**. We have just started an Instagram (**geim_UoN**) where we are plan to post about different mathematicians, etc. We were wondering if we could **post the posters** you have helped create at Queen Mary?

I'd be really grateful if **you could attend** and say a bit about what you have been doing in Math with the diversity stuff

Increasing our Reach

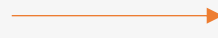
Hey, just wanted to email to say that **I loved your talk at Piscopia** last week! I loved the mindset of "make it so easy they can't say no" for decolonising the curriculum, **will send on the work** you have done **to our schools' EDI committee**. Was going to say as well, would be happy to do one of those videos if you

I would really love to put some of the posters of the biographies of diverse mathematicians around the breakout spaces here in the maths building **at Birmingham**. Is it possible to get access to these posters?



I am currently teaching Maths at a **North-West London Secondary School** and have been looking for **inspirational resources** to use with our students and have come across the work that you have done on diversity within the Mathematics curriculum. I understand that you will be giving a talk in October, which unfortunately falls within term time for us, however, I was wondering if the resource that you have put together is available to the public as I was not able to find it online. **I think the biographies will be of interest to our students who themselves come from a diverse range of backgrounds** and may help spark a greater interest in taking up the subject beyond secondary education. We

Uncredited



67 The ENIAC Six: Betty Holberton, Jean Jennings Bartik, Kay McNulty, Marlyn Wescoff and Ruth Lichterman and Frances Bilas Spencer

Computing and Programming

Keywords: Female, Uncredited, Coding, Awards, Human computers

These six women were pioneers in programming and were tasked with successfully programming the world's first modern computer.

In 1943, the U.S army recruited, McNulty, Jennings, Snyder, Wescoff, Bilas and Lichterman to program the Electronic Numerical Integrator and Computer (ENIAC). This was needed urgently so that ballistic missile trajectories could be calculated during World War II.

The roles of these mathematicians involved solving complex equations associated with firing tables, and they were given very little guidance to complete this massive task. At the time, the women were not granted clearance and were basing their work off of blueprints and interviews with engineers. Despite this, they were able to develop and create sub-routines, nesting and more, all which still remain relevant today. The computer was used until 1955 when it was decommissioned, but up until then was used in the nuclear fission calculations and weather simulations needed in order to create the hydrogen bomb.

Ultimately the credit for this exceptional piece of work has been credited to the designers of the ENIAC, John Mauchly and John Presper Eckert, and the work of the programmers has been not widely credited. This was largely due to the stigma surrounding mathematical computation at the time as it was considered 'too tedious' for the male engineers. The neglect of these 6 mathematicians was carried on, with none of them being invited to the celebratory dinner, and when photographs emerged, suggestions of Wescoff and Lichterman being models as opposed to large contributors to the project.

In 1997, the work of these six women was finally recognised as they were inducted into the Women in Technology International Hall of Fame.

Read more via [The Medium's Article](#); 'Remembering the Eniac Six'



68 Dr Gladys West (1930 - present)

Mathematical modelling, Computer Programming, Applied Mathematics

Keywords: Female, Black, African American, Uncredited, Awards

Dr Gladys West produced work that enabled the development of the GPS, but due to her being a black female during a time where segregation was still prevalent, she is known as one of the 'hidden figures' of history.

Growing up working in the fields of Virginia, it was expected that West would follow in the footsteps of her parents and either work on the farms or on the tobacco processing plant. However due to her aptitude for maths and problem solving, West was able to graduate valedictorian and pursue mathematics at university level.

In 1956, after pursuing teaching in segregated schools, West was hired by the US navy as a computer programmer and a project manager. Then in the 60's after working on an award winning piece of research, proving that Pluto's motion was relative to Neptune, West's talents were recognised and she began to analyse satellite altimeter data from NASA's Geodetic Earth Orbiting program, to create models of the Earth's shape, her team managed to reduce the processing time, again, proving her proficiency. This then led to her spending the 70's and 80's using programming calculate the shape of the Earth, a geoid. In order to this, West created an accurate geopotential model with complex algorithms accounting for all factors impacting the shape of the earth. This model was later used as the basis of the GPS.

In 2018, West's work finally received the deserved recognition as she was inducted to the United States Air Force Hall of Fame, one of the highest honours in space command. That same year, West won the award for "Female Alumna of the Year" at the Historically Black Colleges and Universities Awards in 2018. Then in 2021, she was awarded the prince Phillip medal by the Royal Academy of Engineering.

When asked about her experience as a black female as she rose through the ranks, West said that "I carried that load round, thinking that I had to be the best that I could be, [...] Always doing things just right, to set an example for other people who were coming behind me, especially women. [...] I strived hard to be tough and hang in there the best I could." And then speaking of the experiences of women today and the impact she hopes she has had, "We have made a lot of progress since when I came in, because now at least you can talk about things and be open a little more. [...] But they still gotta fight."

Read more on [Britannica](#)



73 Ron Buckmire (1968 - present)

Fluid Dynamics; Numerical Analysis; Mathematical Education

Keywords: Queer, Grenadian, Outreach

Ron Buckmire (1968) is a Grenadian-American applied mathematician and mathematics educator. His love for mathematics truly kicked off when doing an undergraduate research project on hypergeometric functions, stating "I could not believe that they would pay you to learn mathematics!" His Ph.D. work looked at computational fluid dynamics, and much of his research uses non-standard finite difference methods to provide numerical analysis for real-world financial models.

In recent years, Buckmire has stepped into the roles of Associate Dean for Curricular Affairs at Occidental College (Oxy) and as Program Director with the National Science Foundation (NSF) in the USA. In his role with Oxy, he oversees all academic initiatives and is responsible for improving the curriculum, and in his role with the NSF he has the responsibility of allocating funding to initiatives which improve undergraduate mathematics education throughout the US. He takes particular pride in his students who graduate with a mathematics degree and go on to teach school children.

Buckmire is also a proud advocate for opening up opportunities in STEM for marginalised groups. He is a co-founder of the LGBTQ+ mathematical organisation *Spectra*, holds positions in many committees for improving mathematics education, equity, diversity and inclusion, and publishes many articles in these areas.

Read more in this [brief summary](#), [his profile at Oxy](#), or [this interview](#).



Extending into SEMS:

- Why do we need a teaching tool integrated into the engineering curriculum?
- How will this happen?
- Future work

Present day mathematician

