

# Equity and Inclusion in Science

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Prof. Sood, the Chairman Board of Governors, Prof. Gowrishankar, Director, IISER Mohali and all the members of the Board, members of the senate, most importantly all of you who are graduating today and all the other friends, let me just say how happy I am to be talking to you on this occasion. Let me first thank Dr. Gowrishankar for inviting me to address all of you on this occasion, thereby giving me a chance to be in this vibrant atmosphere filled with the energy of the youth. Then of course let me congratulate all of you who will be receiving your degrees today and will be stepping out in the world. Some of you will continue in the academia, some will explore careers in technology and some others will tread on paths not necessarily directly related to Science and Technology but will be involved in employing it for society and in everyday life! All of you deserve special congratulations, in the backdrop of the past two years which have been difficult, no doubt for all of us, but particularly hard on you students. Let me wish that each of you can move on paths that your heart desires and that you succeed in the chosen endeavour, but more importantly I also wish that you enjoy it! As the saying goes it is not the destination that is important but the journey towards it.

I should tell you that I myself could not attend a single convocation of mine. Thus I was never in the position of those among you who are graduating today. So I had to think a bit hard as to what I should chat with you about. I know you have been immersed in different aspects of Science and Technology for the past years that you have spent in your respective courses. I did not want to talk about anything science. But I thought I could chat with you people about something science-related, which would have relevance also for those who will not necessarily choose a life in science. I would specifically talk about why is it important to achieve equity and inclusion in science. I will discuss further what role can all of us, scientists, scientific institutions and society at large play towards that end!

Already, I can see question marks appearing in the eyes : “It is clear that equity and inclusion ( $E\&I$ ) in social processes and context are very important, but why should that be an issue at all in the  $S\&T$  ecospace where objective, data based thinking is the norm? ” I hope to convince you that even in this space we need to think about  $E\&I$  and insist on diversity that can bring it about. I also want to emphasize the advantages that diversity naturally brings to  $S\&T$  ecosystem by adding more dimensions to it. This in turn can only further its excellence.

Since we are all scientists, let us begin by defining certain words which I have already used. Diversity in scientific processes means participation of different diverse groups: it can be diversity of race, gender, language, social/economic class, geographical region, physical abilities, knowledge systems so on and so forth. It is obvious that intellectual abilities are not dependent on any of these attributes. Hence one should have expected equitable representations of the various groups in processes of science. Equally obvious is the fact that in real life this is far from being true and quite a few among the above mentioned groups are under represented. Striving for diversity will bring about *inclusion* for those groups which have been almost excluded from the processes of science, such as traditional knowledge systems and *equity* for those under-represented groups where some *inclusion* already exists, an example

being gender. Thus diversity can help us move towards *E&I*. In view of the vast nature of the subject, I will focus only on three of the areas: race, gender and knowledge systems!

To begin with let me try to address the question that I had raised above as to why one should discuss diversity (or *E&I*) along with *S&T*? Another way of asking the same question might be 'Does diversity necessarily add to the excellence of *S&T*?. To begin with any creative activity can only benefit from participation from diverse group as it receives a broader range of intellectual inputs. Science is a creative activity and the need for diversity is indicated by a pragmatic outlook that humanity would want to make full use of its intellectual capital. We can only add to the success of an enterprise by ensuring that we use our resources fully.

Yet another way of answering this question is by quoting from a letter written by 2000 US physicists (<https://eblur.github.io/scotus/>) to the Supreme Court Justices of the United States. This was in answer to a question asked by the Chief Justice Roberts (to be fair to him perhaps a rhetorical one) "What unique perspective does a minority student bring to a physics class?". The physicists asserted three things in this letter. "1)Indeed, science relies heavily on consensus about acceptable results as well as future research directions, making diversity among scientists a crucial aspect of objective, bias-free science, 2) They bring their background, ways of thinking, methods of applying physics to real world problems, and the potential to educate others through their unique perspective and 3) The benefits of inclusivity and equity are the same for physics as they are for every other aspect of our world."

In fact Willmien Kets and Alvaro Sandroni of Northwestern University studied effects of diversity (<https://fortune.com/2015/12/16/affirmative-action-u-s-supreme-court-diversity/>) on action taken by the members of a group. They concluded that "Diverse groups are less conformist and more willing to go against the status quo if that leads to better outcomes." Since 'thinking out of the box' definitely is important for advances in science, the nonconformist thinking encouraged by diversity is an intangible that can contribute only positively to the advancement of science. So it seems to make pragmatic sense to think about *E&I* in *S&T*.

Of course it is clear that the humankind has made enormous progress in unravelling secrets of nature and harness many of them for developments. It is equally clear that at least in the last three to four centuries this journey has been dominated by white caucasian males and there has been very little diversity in science: either of gender, race, geographical region or knowledge systems. It would be silly to say that lack of diversity or *E&I* has impeded the development of excellent science. A more appropriate question to ask is: can we think of examples where a lack of equity/diversity has caused a loss to science or where equity/diversity have been responsible for a gain in science. In fact, I would like to quote some examples of both, the gain due to presence of diversity and possible loss due to exclusion of groups from processes of science due to biases. Here I will mainly discuss gender and racial diversity.

Let me begin with the latter. I will tell you a story of a very famous mathematician. Her name was Sophie Germain. She was a mathematician who worked on number theory and theory of elasticity. She was the first woman mathematician ever to receive a prize from the French Academy of Sciences. She lived from 1776 to 1831. Her interest in mathematics was awakened when she read books on mathematics in her father's library during the forced stay at home after the fall of Bastille at the age of 13. However, she was not allowed to study mathematics to pursue it as a career or even enter the newly formed Ecole-Polytechnique because of the biases against women at the time. She had opposition from the family as well, who luckily

finally relented. She studied under a pseudo (male) name M. le Blanc. The brilliance of M. le Blanc's work introduced her true self to the leading mathematicians of the time like Lagrange and Gauss. She made very important contributions to number theory including a possible beginning of a proof of Fermat's last theorem, which was finally proved two hundred years after Germain's efforts and 350 years after Fermat stated the theorem. However, her lack of formal training was always a big hindrance in her work and caused delays. Looking at what this self trained mathematician did achieve even in the absence of proper formal training and of a strong discourse with the brilliant mathematicians of her generation, one wonders what the field of mathematics might not have gained if it were not for the bias that it was not proper for a girl/woman to study mathematics.

On the other hand, there is an interesting story of the 'Hidden Figures' behind the early progress of the American aeronautical and space program. These were the african-american women of the deep south who had training in mathematics and were recruited by the NACA (a previous avatar of NASA) as the men were out fighting war. These group of women contained the likes of Dorothy Vaughn who was the first head of the computing group that NASA had and also the mathematician Katherine Johnson whose calculations of orbital mechanics were critical to the success of the first ever and subsequent U.S. crewed spaceflights. Her work directly aided the US space program which was clearly lagging behind the Russian one in the beginning. There were a lot of obstacles in their involvement in the program because traditionally they came from a group that was not considered to have the capability. But their presence and diversity did propel the cause of the American space program further.

In fact, the recognition of their effort was also limited which is quite the norm for under-represented groups. As Margot Lee Shetterley describes in her book, these figures remained 'hidden' for a long time till finally Katherine Johnson was presented the congressional medal in 2015 when she was 97 years old. They are forgotten to the extent that even today, the small number of women in the subjects of mathematics and computers in the US, is taken by some to indicate that women lack the ability and/or interest in the field!

I want to tell you a much more recent story about the impact of the diversity on science. In behavioural sciences, female birdsongs has become a subject of great interest in the past decades. Importance of such investigations to our understanding of social behaviour of a group does not need to be spelt out. According to a paper published in 2020 in the journal 'Animal Behaviour', majority of scientists who are spearheading progress in the subject are women.

An example in the context of usage of diverse knowledge systems can be Aurveda. Use of the Ayurvedic medicine Guggul as cholesterol lowering agent (the work of the Dr. Satyavati, the first woman DG of ICMR) or use of Sarpagandha in the development of Reserpine, a medication against hypertension are well known. In fact, even in the recent times, the alternate medicinal systems like Ayurveda and Siddha, did offer new, successful avenues for treating Covid-19. The idea here is to validate the older knowledge systems using modern methods and then innovate further using these validated knowledge.

Of course science is objective and talks about universal truths. So 'Newton's laws of motion' would have been the same no matter what the gender of the discoverer was. That is not the point. However, issues in science one chooses to investigate, processes that are put in place etc. can be influenced by our cultural or racial or gender background! Thus diversity can impact, quite directly, both the choice of scientific quests and also the way they are pursued.

Who we are affects what investigations we choose to undertake. We can see this in the story of Anandibai Joshee, the first Indian woman to become a medical doctor from the US, whose choice of the thesis topic on 'gynaecological problems of Hindoo women' was influenced by her having lost her child at the age of 14. The much more recent story of Shalini Arya of ICT, whose work on 'nutritious chapatis' was fuelled by her childhood experiences, makes the same point.

In fact, for a long time the studies funded by NIH in the USA covered only white male cohorts and a very small fraction of the funding of the NIH in the USA went to investigate health problems of the women. The situation changed once the community applying for the funding became more diverse. At another level, Joy Boulamwini of the M.I.T. media labs observed that the 'face recognition programs' failed as much as 35% of the time when used with african-american women. The simple reason being that these were developed by and trained on, white caucasian males. This observation underscores the need of diversity in the workforce, which may become critical now in these days where we are beginning to use AI/Machine learning everywhere.

This lack of awareness of cultural differences can affect also processes that the science administrators put in. Recently, an online application form for a special science scholarship, devised by one of the state agencies in Karnataka, did not allow the applicant to proceed without putting father's name. This made life difficult for the children in a particular community, who do not always know the father's name. In this case the administration did not take care that the processes they put in place are equitable.

What all this tells us is that it makes pragmatic sense to have diversity in the scientific work force, at all levels, to increase the scope and effectiveness of our science quests. However, even a cursory look at the scientific community, the world over, indicates a glaring lack of diversity and *E&I*. The obvious question then is "How to change things?". Of course to find a way to change, we must first understand the root causes of the inequity. Equally importantly, we need to figure out how to set targets. How can we judge what level of diversity is correct or is there even such a thing as 'correct' level?

One must understand that the lack of numerical representation is a symptom. One can set some numerical targets and try to attain them. That is of course necessary but it may not be sufficient. The solutions we suggest have to address the reasons. We must also appreciate that each type of inequity might have different set of some obvious causes. The state, institutions and society can put in place measures to address these. But the thesis for the last five to ten minutes of my conversation with you, is that in addition to these obvious reasons, almost all the inequities are also fuelled by some not so obvious causes. Further, these happen to be common across different types of inequities. These are the 'invisible' biases!

I will illustrate both of these by taking example of one inequity that I know a few things about: viz. 'women in science'. In India we have no shortage of young girls studying and excelling in STEM. For decades the majority of medal/prize winners at schools and universities have been women. I am very happy that the fraction and success of women students is substantial also at the young, exclusive institutes like yours. But when it comes to the share of women among practicing scientists, among the science laureates, scientific leaders and high impact science administrators, then they are more exception than the rule. The first real drop off in India comes after women finish their Ph.D. and of course numbers go on dwindling as we

go to positions of seniority, authority and decision making.

In case of women scientists in particular there are two obvious causes. One is the oft quoted career and family balance which of course is common to all professional women. The other is the presence of simultaneously ticking body clocks and the science clocks in the period right after the doctorate. The first clock means one must start a family and the second means one really needs to create one's niche in science and put down ones roots in the world of science. Lot of women drop off the path during this period. I am happy to say that we do have schemes in India to address this issue. But they are mainly designed assuming that this break is inevitable and provide ways to come back. They do not yet address what kind of support structures be created such that these speed breakers do not stop the journey altogether and their presence is accounted for in the career progression schemes.

In addition to these causes there exist also additional obstacles which are not so obvious. These are the biases: conscious and unconscious biases. Biases about what women can do and can not do, biases about what women should do and should not do.

In fact a simple example of this unconscious bias came to my notice with the experience of the daughter of friends of mine. When given the book 'Joy of making Indian Toys' by Sudarshan Khanna, she made less than half of them. When asked, she said she did not make the others as they had pictured boys making them. She took it to mean they were not for her! I can give many example of such biases. Some jokes about surgeons, for example, involve our innate bias that surgeons can only be males!

In fact in case of practice of science there is a horde of these invisible biases and they impact the mentoring we give to young women! They impact decisions young men and women take! This in turn can directly impact both the number of women that stay in *S&T* and what they can achieve In my opinion almost all of them arise from **(lack of)** importance attached to women's participation in science in the eyes of society and scientists. In fact a survey that we conducted a decade and a half ago, 'What fraction of trained scientific woman power are we losing and why?' indicated to us that these invisible biases actually feed back into the obvious obstacles.

The problem is not limited to India. Even the Royal Society accepts these unconscious biases as one of the reasons for the gender inequity in science. There is a wonderful film: 'Picture a Scientist'. It is available on Netflix. Do watch it. It presents results of experiments done in the USA, clearly indicating how unconsciously we associate certain professions/abilities with different genders!

In fact while I talked about unconscious bias by taking gender as an example, it is not limited to gender inequity alone. Think how often we do not listen to a person carefully because he or she can not speak fluently in english : the 'lingua franca' of Indian science. Think how often in science we tend to pay less attention to people who come from rural backgrounds or are trained in less stellar institutes. So one request I want to make to all of you is that in your life, both in and out of science, pay attention to the message without it being coloured by your biases about the messenger. That is my first suggestion of a cure. To be 'aware' of ones own 'invisible' biases! To introspect and autocorrect.

Again this is necessary but far from being sufficient. We need to advance on two fronts. One is making policies, while ensuring that they themselves are not affected by the invisible bias! The second is to work towards changes in social attitudes and conventions. Being aware

of one's own invisible bias that I quoted is just one of them! Awareness of the situation and of the need for such a change is essential for successful implementation of the policies themselves!

Luckily, the Science, Technology, Innovation Policy of India (STIP-2020) has realised the need for such a holistic treatment of the subject across all aspects of science policy and has a chapter on 'Equity and Inclusion in Science'. There are many recommendations there. Some of them will be hopefully accepted for implementation as policies as time goes by.

Successful implementation will require both changes in Institutional processes changes in societal processes and mindset. Commitment from different stakeholders is necessary. That can come only from creating awareness: awareness that diversity and resulting *E&I* is beneficial not just for the excluded groups but also for science and that it makes pragmatic and economic sense. This thinking has to become part of our ecosystem!

Going forward, please introspect and autocorrect for your invisible biases in your professional and personal lives! We need to be inclusive! It begins at home in the way how you will treat your partner/spouse, your children! All of us, individuals, scientists, science administrators and institutions all need to be inclusive in all we do!

I end by quoting a statement I made in an editorial of Current Science in the context of gender but which in fact can apply to all the inequities: "The path to go to a situation when we will just speak of scientists/engineers and not their gender, surprisingly, goes through the path of being very aware of the same for a while!". All of us, individuals, society, and the governments need to work towards this. I request you to keep this in your mind as you go forward in your life on this important day!



# 11<sup>th</sup> Convocation of IISER Mohali

May 26, 2022 at 3:00pm

Auditorium, Lecture Hall Complex, IISER Mohali

**Chief Guest:** Professor Rohini Godbole (IISc Bengaluru)



Professor Rohini Godbole obtained her PhD from SUNY Stony Brook in 1979. She has been affiliated with TIFR Mumbai, University of Mumbai and IISc Bengaluru. She retired from the Centre for High Energy Physics at IISc after 25 years of service. She has worked at a large number of universities and institutes in her professional career, including CERN in Geneva. At present she is an Honorary Professor at IISc Bengaluru.

A particle physicist by training, she has over 300 publications on the standard model of particle physics, and physics beyond the standard model.

She has been an avid supporter of the cause of women in science. Her work has been recognized by a number of fellowships and awards: She is a fellow of TWAS and has been elected to the three science academies in India. Her extensive contributions to science and society have been recognized by the *Padmashri* (2019) and the *Ordre National du Mérite* of the Government of France in 2021 amongst numerous recognitions.



# 11<sup>th</sup> Convocation of IISER Mohali

May 26, 2022 at 3:00pm

Auditorium, Lecture Hall Complex, IISER Mohali

- 3:00pm: Academic procession starts
- 3:02pm: Academic Procession reaches the Auditorium
- 3:04pm: Invocation
- 3:05pm: Chairperson BoG declares the convocation open
- 3:06pm: Award of degrees
- 4:10pm: Signing of the convocation register
- 4:12pm: Exhortation of graduates by the Senate Chairperson
- 4:15pm: Award of Medals and Certificates
- 4:20pm: Director's Report
- 4:35pm: Introduction of Chief Guest by the Chairperson, BoG
- 4:40pm: Convocation address by the Chief Guest
- 5:10pm: Chairperson BoG declares the convocation closed.
- 5:11pm: National Anthem
- 5:15pm: Academic procession exits the Auditorium

Requesting your participation and best wishes for the graduates.

**Chairperson, Board of Governors:** Professor Ajay Sood (IISc Bengaluru)

**Chairperson, Senate:** Professor J Gowrishankar (IISER Mohali)