# Diversity and Inclusion: But, I Teach Science!

**Nishat Alikhan**

**Polytechnic School – Pasadena**
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## Abstract:

Science education, equity, and social justice are not mutually exclusive. It is a disservice to students to teach Science without including social justice and without thinking about diversity and inclusion as lenses to looking at the curriculum. With everything happening in the world right now, it is more important than ever to have all voices represented to garner the best ideas. Teaching using the diversity and inclusion lens requires that educators explore various components of Science education such as curriculum, projects, and representation. Tweaking and/or enhancing each of these components creates a more equitable Science learning experience. There are keys steps to follow to achieve this – including, but not limited to choosing who is featured in the classroom and whose contributions are validated. Additionally, connecting concepts to social justice also serves to make Science education more diverse and inclusive.


## Author / Presenter Biography: Nishat Alikhan

Born in Chicago, Illinois, Nishat holds several degrees and memberships to professional organizations. She earned a BS in Microbiology from California State University – Los Angeles in Los Angeles, CA in 2005. She, then, went on to earn a Masters in Clinical Microbiology from The University of Nottingham in Nottingham, UK in 2006. Nishat has been teaching full-time ever since. Nishat is a member of the National Science Teachers' Association, the California Science Teachers' Association, and the California Math Council. Nishat is a dedicated, enthusiastic, hard-working Lower School Science Specialist at Polytechnic School in Pasadena, CA, currently teaching Science to 2$^{nd}$, 3$^{rd}$, 4$^{th}$, & 5$^{th}$ graders. In addition to her teaching role, she serves as a co-chair of the Social Justice, Diversity, and Inclusion Cohort, a member of the Faculty Curriculum Committee, a member of the Global Initiatives Program, and organizes the annual Engineering Challenge and Fun with Science Night. Outside of school, Nishat serves as the Vice President and Special Awards Chair of the Los Angeles County Science & Engineering Fair, a member of the Judges' Advisory Committee for the California State Science Fair, and an English as a Second Language Teacher for adults.

# Diversity and Inclusion: But I Teach Science!

In this increasingly disturbing time, it is important now more than ever before to teach using the diversity and inclusion lens. For some subject areas, this idea seems easier, but if you teach Science, you may be wondering how you can teach Science using this lens. Essentially, you may be wondering, “how do I teach Science through the lens of diversity and inclusion, thinking about equity and social justice?”

To think about this question, one needs to ask a few different questions first. A question such as “what is diversity and inclusion?” and “what does the diversity and inclusion lens look at when it comes to teaching and curriculum?” and “can I teach social justice in a Science class?” Merriam-Webster defines diversity as “the condition of having or being composed of differing elements: especially: the inclusion of different types of people (such as people of different races or cultures) in a group or organization.” Furthermore, according to inclusion.me ltd, “the aim of inclusion is to embrace all people irrespective of race, gender, disability, medical or other need.” When these two ideals are combined and used as a lens through which to look at education, it seeks to make education more accessible to all students. It would appear that simply changing the books in literature or using a more holistic approach to history would be the easiest ways of addressing these needs. However, as a Science educator and a self-proclaimed, proud social justice activist, I firmly believe that Science education can be equally accessible to all students regardless of their background.

It has already been mentioned that diversity and inclusion has never been more important than it is today! Students in our schools today are the future leaders of the companies, industries, and communities of tomorrow. They are developing the requisite skills now. For this reason alone, schools need to ensure that students are able to access their specific curriculum and develop a healthy, positive self-esteem, and self-identity as well as the learner identity. Students need to see themselves reflected all around them; in the student body, in the faculty they see every day, and in the curriculum. Poet and feminist, Adrienne Rich says, “When someone with the authority of a teacher, say, describes the world and you are not in it, you have a moment of psychic disequilibrium, as if you looked in the mirror and saw nothing.” Diversity and inclusivity is all about – seeing yourself as a positively contributing member of the world in which you live. It is about making each student feel like a part of the community.

Okay, so diversity, inclusion, and equity is important, now how does this translate to curriculum? Students see themselves in the heroes, she-roes, and they-roes in the books that they read, but they also see themselves in the villains and the supporting characters as well. Students see themselves and members of their ethnic/racial identities in the history we learn. So, if every book read shows members of their ethnic/racial heritage all

represented in a certain way, students begin to believe that that is the only thing members of their ethnic heritage can be. Tackling these preconceived notions in Science is especially important because Science is mired in a great many stigmas about the success of women and people of color. A few years ago, the Harvard President, Lawrence Summers remarked that women were genetically predisposed to not being good at Science. This shows that women face obstacles, including societal expectations and pressures, to having careers in the STEM industry. Neil deGrasse Tyson responded to this by saying, “So, my life experience tells me that when you don’t find blacks in the sciences, when you don’t find women in the sciences, I know that these forces are real, and I had to survive them in order to get where I am today. So, before we start talking about genetic differences, you gotta come up with a system where there’s equal opportunity. Then we can have that conversation.” This powerful statement says that before we can attribute genetic predispositions or make other “God-like excuses” to account for the underrepresentation of women and people of color in the Sciences, we need to look at the systems in place. This statement supports the importance of equity in Science education.

Educators understand that many STEM problems/projects require a variety of perspectives to find as many possible solutions to problems in order to distil the best one. This process is severely limited if only a few or only the same perspective is present at the decision-making table. There are several ways to integrate equity practices in the curriculum. Looking at specific classroom systems and practices, helps look at educational equity. Does every student have access to the class materials? Is there anything students are asked to provide? Do students who need teacher attention receive that attention? These questions help further address the diversity, equity, and inclusion issues as applicable to education. Science is one area in which these issues are naturally examined on a regular basis.

Looking at the curriculum, one may ask – what does diversity look like in science curriculum? Diversity asks us to look at the elements included within the curriculum. Elements such as sources of information, which scientists are featured, projects, and what potential career paths are highlighted. Additionally, access to quality Science programming must be considered. Science is highlighted as one of the main avenues of building students’ critical thinking. Great potential exists for doing equity work while building critical thinking by asking students to evaluate diverse sources of information and create evidence-based arguments and/or critiques to support an idea. Many excellent, oversees-based, student-friendly science websites provide other perspectives that students may access.

It is easy to feature the more popular scientists (typically white men of European descent) in classrooms and in Science inventor narratives because they are more widely acknowledged, credited, and publicized. A quick Google image search of popular scientists, engineers, mathematicians shows a slew of predominantly older, white, male

scientists, supporting my previous claim. These images, when introduced to students, sends the message that only people who look like these images can be scientists or STEM professionals. It limits the possibilities students see for themselves.

To tear down this limiting barrier, it is important to analyze the demographic information of the scientists whose images and information are shared with students. Questions, such as, “What is the race, ethnic heritage, gender, age, socio-economic status, etcetera of the scientists being discussed in the classroom?” It is especially important to the development of the Scientist identity to feature scientists of diverse backgrounds. Featuring scientists that reflect the students’ backgrounds allows them to better identify with the scientists, allowing students to believe that people who look like them and/or have had similar experiences as them can be scientists by providing role models for their aspirations. Appendix 2 includes a list of lesser-known scientists who students in my classes begin to learn about, especially through our traditional scientist Biography project. This is list is not complete, but a good starting point.

Another way to support the development of a positive Scientist identity is to provide real-time, real-life guest scientists or STEM professionals to share their story and work with our students. Many independent school communities include a variety of real-life STEM professionals just waiting to be approached. A survey sent out at the beginning of the year, in a newsletter or on back-to-school night is a great way to prime the parents and invite the STEM professionals in the community to think about sharing their perspective. Appendix 1 is the survey I send out within my first newsletter in fall. Typically, several parents return this survey and are professionals that are happy to come talk to students, especially with their students’ classes. If this is not an option at a school site, another option to make this happen includes approaching local chapters of scientific organizations (Lapidary Societies, Aviary Clubs, Planetary Societies, Rock Clubs, etcetera). These groups usually have educational outreach positions that work to share their passions and expertise with students. Another potential source of STEM people are local colleges and universities that have robust outreach departments that can also aid in the connection of scientists to schools. Contact your local colleges and universities to inquire about this. Many will also invite classes to take tours of their labs, so students can see people working in these institutions with their specific equipment.

The third part of an equity forward curriculum includes projects. Science projects can be especially tough to think about because it is all about a scientific endeavor – conducting an investigation, learning about a concept, or examining what a scientist is. This is also, one of the easiest areas to look at through the equity lens – is there equal access to all the materials? How are student groups determined for group projects? Are strong students paired with weaker students or are strong students paired with strong students and weak students paired with weak students? Are specific roles assigned to

ensure everyone is actively involved in the project? Are the same students always in the same roles? What explicit skills do students need to complete this project? Who taught it to them and how do you (the educator) know the students know? All questions to ask when setting up a new project. One project that was re-imagined using the equity lens was the traditional Scientist Biography project. Instead of allowing students to pick their own scientist/engineer to study (with the result usually being a well-known, famous scientist, like Einstein), providing students a list of lesser known, equally important, somewhat forgotten female scientists/engineers and scientists/engineers of color to choose from and assigning them to find specific information about each person. This allows students to make discoveries about their person and how information about their lives and contributions were recorded. Students have found less information about their person on the list. Students are able to understand the bias involved in recording information and how credit was or was not given for their work. Appendix 2 is the list of Scientists / Engineers used in my classroom and Appendix 3 is the guidelines for this particular project in my classroom.

The last part of an equity forward curriculum includes what is actually part of the curriculum. This would include more than just the academic concepts, but the impact of the economics and the political realities around that concept. Looking at the connections and intersections between current events and the concepts being taught including the historical implications. For example with Climate Change, are students learning about Climate Change in a vacuum? Are they looking at how Climate Change is affecting other countries and about the Paris Climate Accord? Are students looking at the impact of Climate Change in the United States and abroad? Are students looking at the health impacts of Climate Change? Alternatively, when students are introduced to weather and other natural disasters, are they making connections to poverty and the impact of natural disasters? It is important as an educator to look at all the sides of the concepts being presented and discussed in a Science classroom. Depending on what state the school is located in and its status as either a public, charter, or independent school, the requirement to adhere to State Standards varies. It is important to know what standards, if any, the school follows. Looking at the standards gives a backbone to what lessons / units are included in the curriculum. It is important to include the application of the concepts students are learning to the greater world. This way students are not learning in a vacuum. Appendix 4 lists some Science / Social Justice Connections to explore in the Science classroom and in Science education. These are just a few examples, there are many more examples one can find doing some basic searching.

Teaching Science through the diversity, equity, and inclusion lens is really important and very doable. It is important that in this time of turbulence, where Science is under attack and the data is being dismissed that we empower students to be thinkers and questioners who persevere. Applying the lens of diversity, equity, and inclusion requires

educators to know their students and tailor their curriculum to meet their students' needs as well as to relate curriculum to current events and examine issues in the right context. Science and social justice are not mutually exclusive. In fact, Science and social justice fit hand-in-hand and work very well together to allow students to more deeply think about their learning and the world they live in.

# uest Scientists in the Classroom

n order to enhance student experiences in the Science Pro-
n at the Lower School, I think it is important for students to
e wide and varied experiences in class. With this in mind, I
ld like to include guest scientists working in a variety of fields
ve students valuable information and / or run special activi-
Furthermore, I want to expose students to a variety of careers
ience.

encourage parents to fill out the following brief Guest Scien-
Parent Survey and return it to the Science classroom or my
hat Alikhan) mailbox in the Lower School Office by Monday,
ber 9th, 2017. Alternately, you may e-mail me the answers to
urvey at nalikhan@polytechnic.org.

will use the information from the following survey to match
s of parent expertise, willingness to be guest scientists, grade
s of comfort, and availability with upcoming curriculum to
lve parents in the classroom and enhance science education.
ents love when their parents can come in and share their ex-
ise with us!

## Contact Info


Nishat Alikhan
Lower School Science
Grades 2-5
Room H23

Polytechnic School
1030 E. California Blvd
Pasadena, CA 91106

(626) 396-6449

nalikhan@polytechnic.org


All class specific information is posted on the MyPoly website.

## Guest Scientists Parent Survey

me: _____ 2. Occupation: _____

ld of Science (Expertise in): _____

there any grade level (2-5) you would **not** like to volunteer in? If so, please indicate which
ade level you are not comfortable with _____

m available to help with (check as many as applicable):

___ Guest Lecturing on a specific Topic
___ Running an Experiment or Demonstration
___ Planning an Activity
___ Working with students on their experiments
___ Other _____ (tell me what you're good at!)
___ Just ask!

nen are you available to help in the classroom?

Monday ___ Morning ___ Afternoon
Tuesday ___ Morning ___ Afternoon
Wednesday ___ Morning ___ Afternoon
Thursday ___ Morning ___ Afternoon
Friday ___ Morning ___ Afternoon
___ irregular schedule, but feel free to call and ask!

ease list any other fields of science you are familiar with and could present on: _____

_____

Appendix 1: Guest Scientist Survey

# Appendix 2: Scientist Biography Choices

## Scientist Biography Choices

1. Katherine G. Johnson
2. Mary Jackson
3. Dorothy Vaughn
4. Ahmed Zewail
5. Alexa Canady
6. Evelyn Boyd Granville
7. Patricia Bath
8. Marie Maynard Daly
9. Chien-Shiung Wu
10. Shirley Ann Jackson
11. Roger Arliner Young
12. Margaret Liu
13. Adriana Ocampo
14. Flossie Wong-Staal
15. Lyndsey Scott
16. Taylor Wang
17. Benjamin Banneker
18. Charles Drew
19. Daniel Hale Williams
20. Garrett Morgan
21. James West
22. Samuel Massie Jr.
23. Azza Abdel Hamid Faiad
24. Seema Prakash
25. Angela Zhang
26. María del Socorro Flores González
27. Deepika Kurup
28. Laura Weidman Powers
29. Christina Lewis Halpern
30. Tanya Van Court
31. Wanda M. Austin
32. Aprille Ericcson-Jackson
33. Mary Anning
34. Mary Sommerville
35. Maria Mitchell
36. Lise Meitner
37. Iréne Curie-Joliot
38. Cecilia H. Payne-Gaposchkin
39. Antonia Novello
40. Ruth E. Moore
41. Ruth Howard Beckham
42. Flemmie Kittrell
43. Ruth Smith Lloyd
44. Marguerite Williams
45. Phyllis Wallace
46. Dolores Cooper Shockley
47. Otis Boykin
48. Lonnie Johnson
49. Guion S. Bluford
50. Percy Julian
51. George Carruthers
52. Ernest Everett Just
53. Ruzena Bajesy
54. Deborah Jin
55. Tsung-Dao Lee
56. Chen Ning Yang
57. Chien-Shiung Wu
58. Steven Chu
59. Samuel Chao Chung Ting
60. Yuan T. Lee
61. Kalpana Chawla
62. Shubha Tole
63. Shinya Yamanaka
64. Satish Reddy
65. V Narry Kim
66. Zia Mian
67. Lisa Ng
68. James Bauer
69. Thomas Jenning
70. Frederick Jones
71. Lewis Latimer
72. John Lee Love
73. Elijah McCoy
74. Norbert Rillieux
75. Madame Walker
76. Maryam Mirzakhani
77. Tessy Thomas

# Appendix 3: Scientist Biography Guidelines

Slides:
First Slide – Title Page

- Name of Scientist
- Your Initials
- February 2017

- Polytechnic School
- Picture of Scientist

Middle Slides

- Scientist's Family Life
  - Birthdate
  - Parents' Names & Jobs
  - Number of Siblings Older & Younger & Their Names
  - Pictures
- Scientist's Childhood
  - Schools attended by Scientist
  - Childhood Interests & Hobbies
  - Pictures
- Scientist's Personal Life
  - Scientist's Spouse (Their Name & When they Married / How they met / Where they met / If divorced – when?)
  - Scientist's Children – names
  - Pictures
- Scientist's Scientific Claim-to-Fame
  - What they did or discovered that led to their fame
  - Did they get credit for their work?
  - How did they benefit from their discovery?

Second Last Slide

- What is the most important thing to know about this scientist?
- What did you learn about this scientist?
- Why is it important to know about this scientist?

Last Slide

- Sources of Information (Complete URLs)

# Appendix 4: Social Justice / Science Connections

1. What is a Scientist?
2. Data Interpretation  Conclusions  Questions
3. Resource Allocation During Disaster Relief
    a. Hurricanes Jose, Irma, and Maria and the Aftermath
4. Biology / Health
    a. Darwin – Survival of the Fittest
    b. Cell Anatomy & Physiology
    c. Genetics
        i. Eugenics – American Eugenics Movement
        ii. Master Race
        iii. Genetic Engineering
        iv. Stem Cells - HeLa
    d. HeLa Cells and Henrietta Lacks
    e. Pathogens
    f. STDs
        i. Tuskegee Experiments / Syphilis Studies
        ii. Guatemala
        iii. Birth Control Pills tested in Puerto Rico
5. Chemistry
    a. Atomic Structure
    b. Nuclear Energy
    c. Iran Nuclear Deal & Trump Administration
    d. Nuclear Energy & Which Countries are Nuclear Powers
        i. Who decides who gets nuclear energy?
        ii. History of Weaponry – Chinese Gunpowder to Present
6. Earth Science
    a. Mapping & Christopher Columbus Myth
    b. Colonialism
    c. Natural Resources
7. Environmental Science
    a. Environmental Racism
    b. Natural Resources
    c. Colonialism
    d. Food Deserts
    e. Distribution of Wealth
    f. Climate Change
        i. Paris Climate Accord

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3. DeGrasse Tyson, Neil. (2009, July). Secular Society and it's Enemies. Retrieved December 4, 2017, from https://www.youtube.com/watch?v=6EkuXfsWmMo.

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