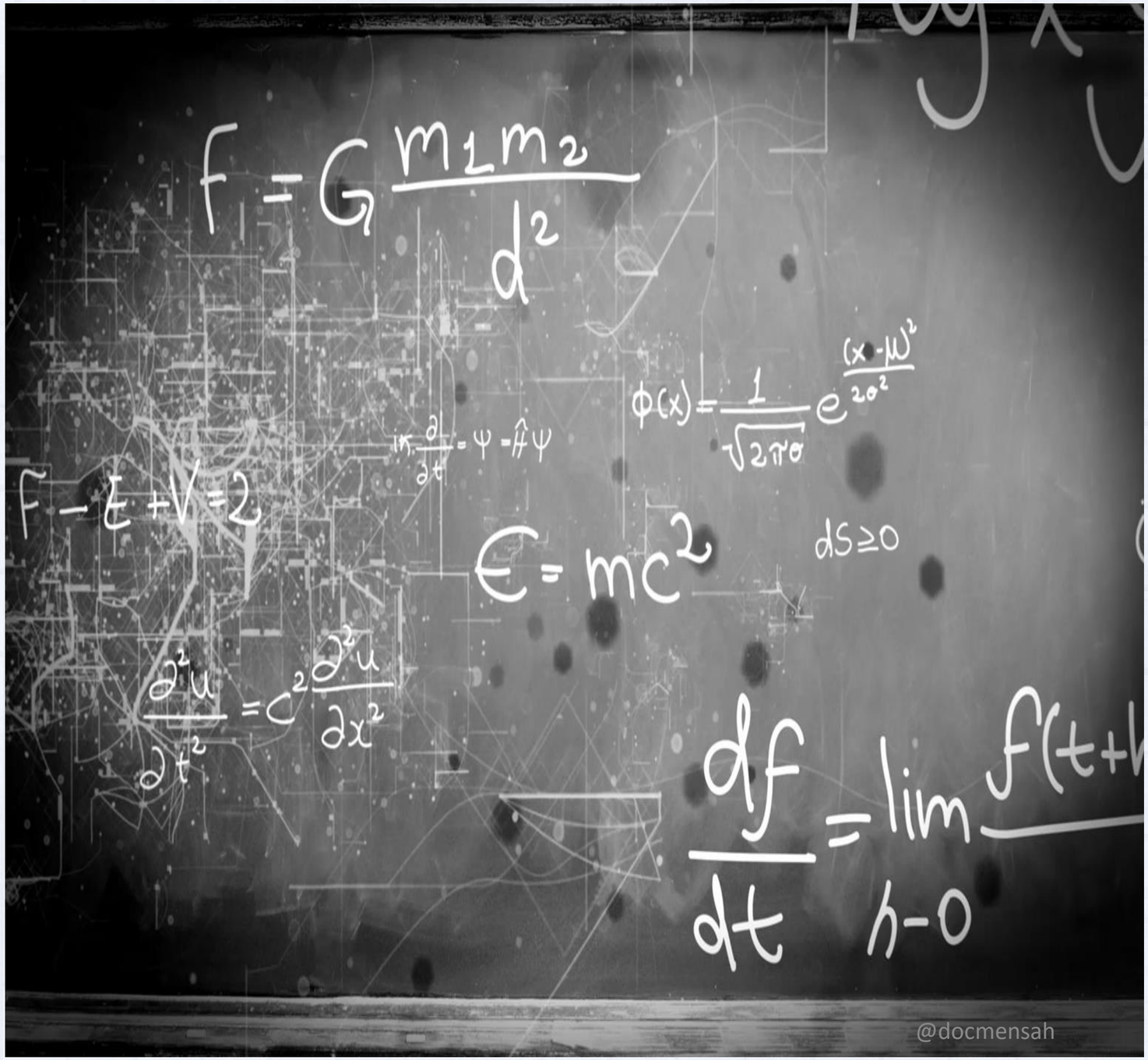


I Didn't Know Inclusion Was For Science and Mathematics, Too

Northern Arizona University
Seminar/Workshop
March 3, 2023

Felicia Moore Mensah, PhD

@docmensah | fm2140@tc.columbia.edu

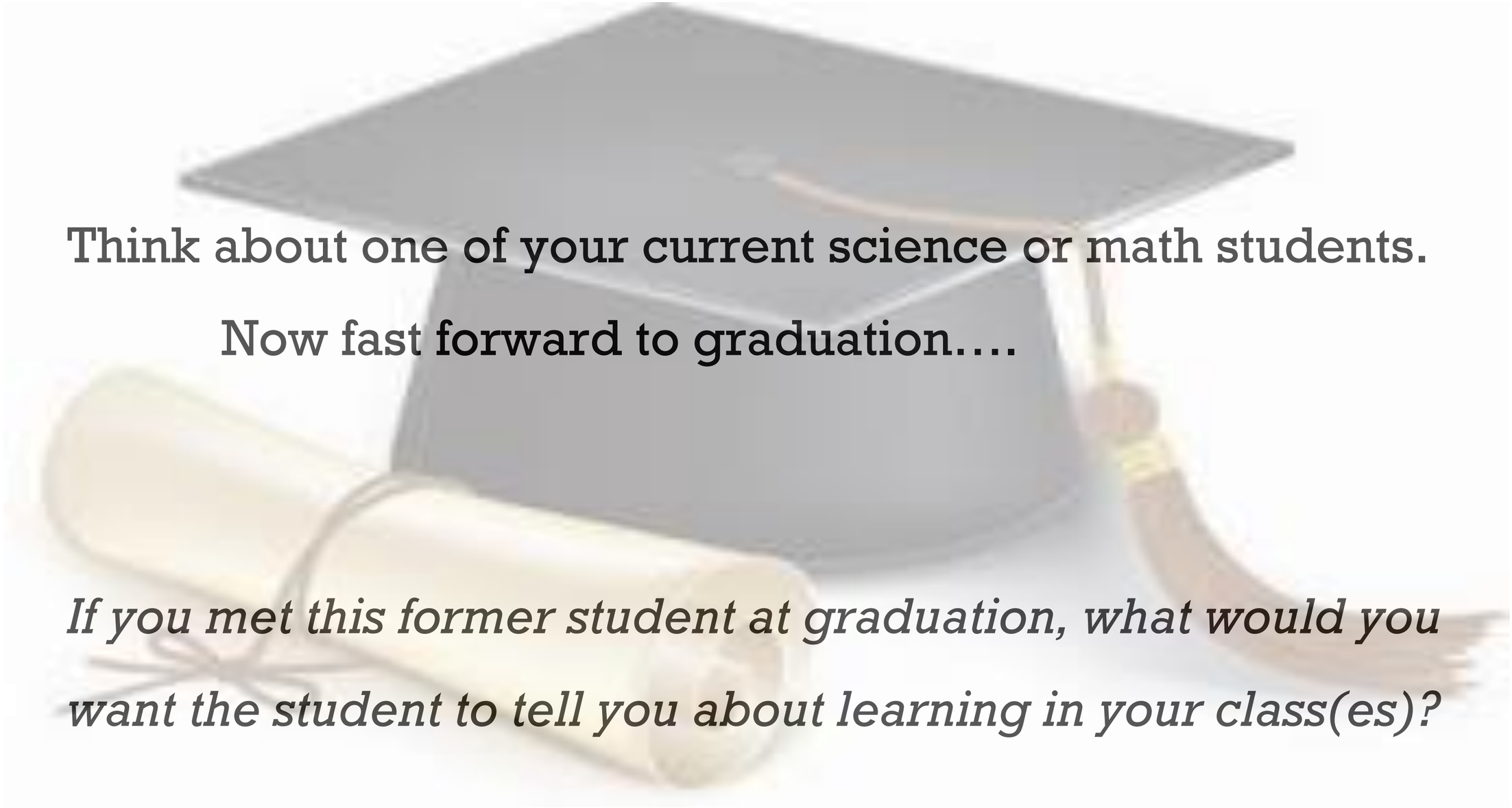
Teachers College, Columbia University

Driving Questions

"Are you being Inclusive?"

- Why do we need inclusion in math/science/STEM education?
- What biases do you hold about students that hinder inclusive teaching and learning?
- How do you work with colleagues & students to promote inclusive classroom environments?

"The [STEM] classroom, with all its limitations, remains a location of possibility. In that field of possibility we have the opportunity to labor for freedom, to demand ourselves and comrades, an openness of mind and heart that allows us to face reality even as we collectively imagine ways to move beyond boundaries, to transgress. This is education as the practice of freedom" (bell hooks, 1994, p. 207).



Think about one of your current science or math students.

Now fast forward to graduation….

If you met this former student at graduation, what would you want the student to tell you about learning in your class(es)?

When you thought about this student….

*How do your students see **you** as their math and science instructor?*

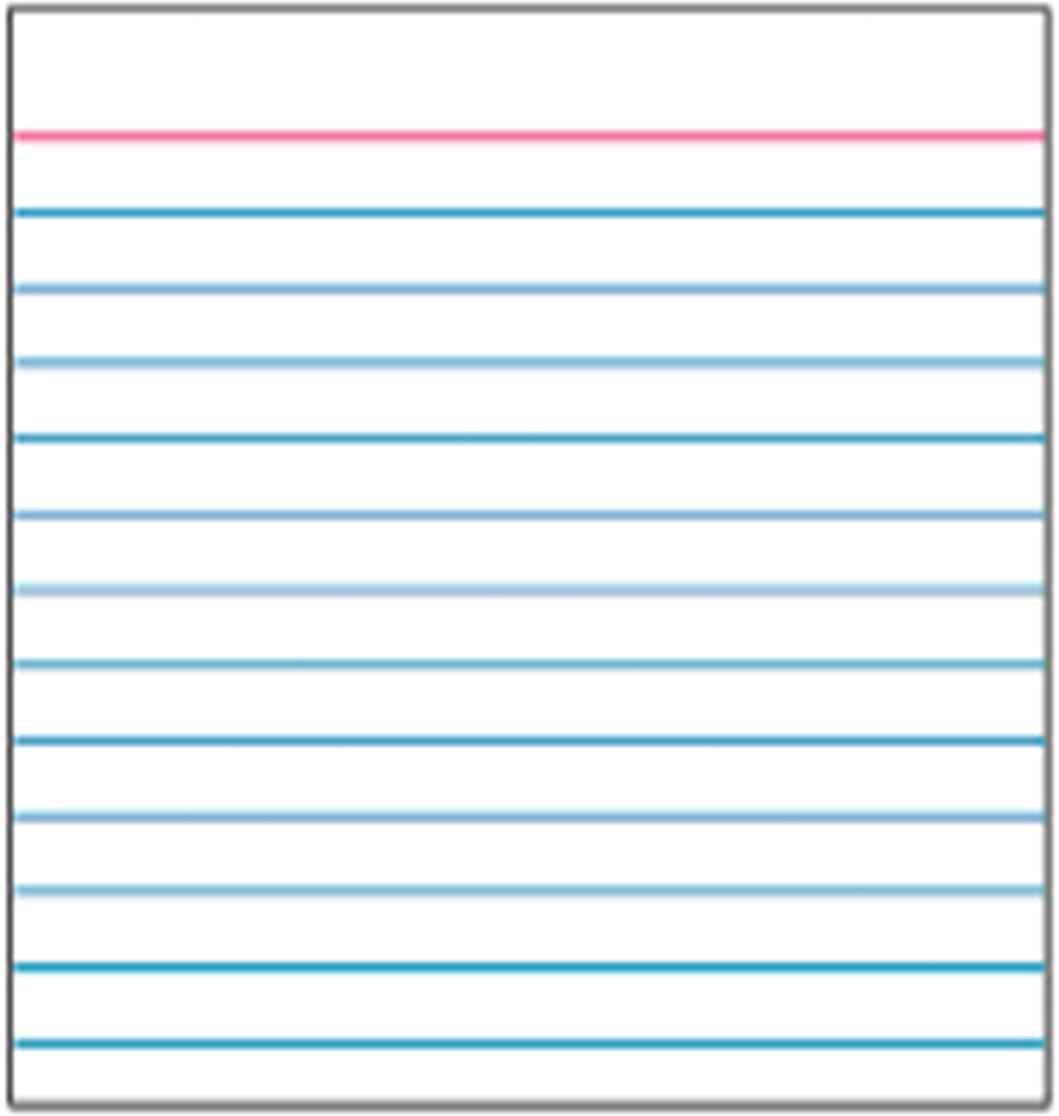
(Renee, Journal entry)

"Although I think it is important to bring multicultural connections into science, it is also imperative to explain societal views of people of color in science. For example, Dr. Mensah an African American female from the south is our science professor and breaking many barriers in science and at TC. I was happy (more like proud) that this was the case but then nervous at the same time because when my colleagues [white preservice teachers] read articles every week about minorities being underrepresented and see the exact opposite everyday (by Dr. Mensah proving statistics wrong), I am afraid they would believe the 'well if she can do it' theory [then what's wrong with other AA people?]. Then on the other hand, I am glad that they see this because sometimes teachers have low expectations for children of color and water down the curriculum because they feel like 'those' students will not understand. I appreciate … incorporating multicultural connections to science [and math], and this is the framework that we should bring into the science [and math] classroom."

Self-Assessment

How are your classrooms diverse?

Review & Reflect

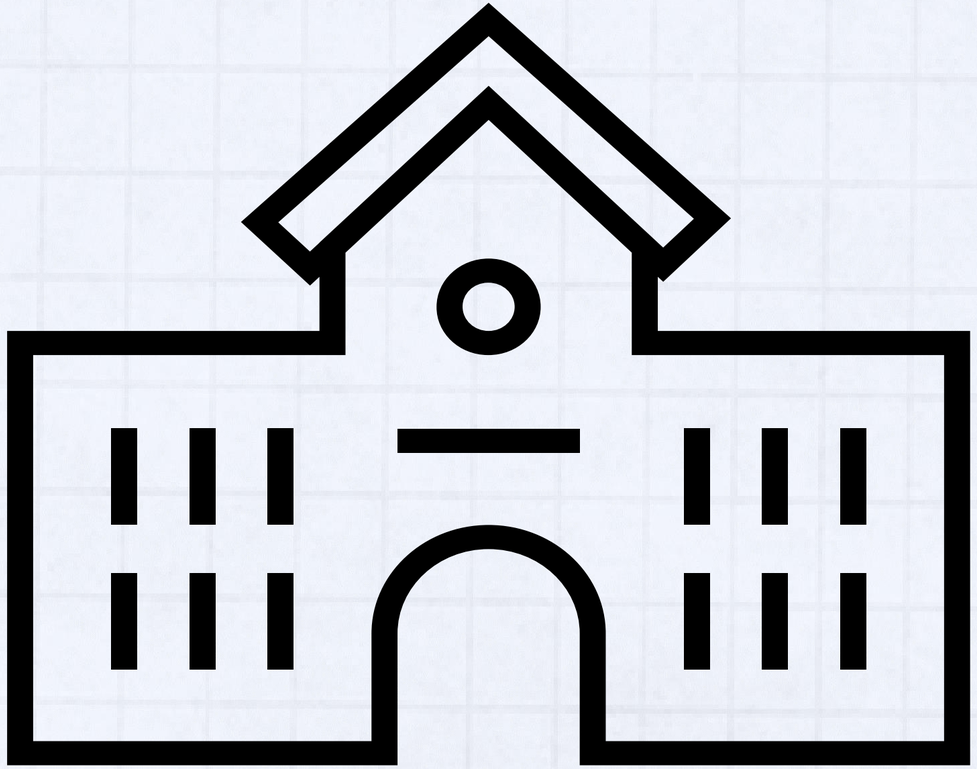


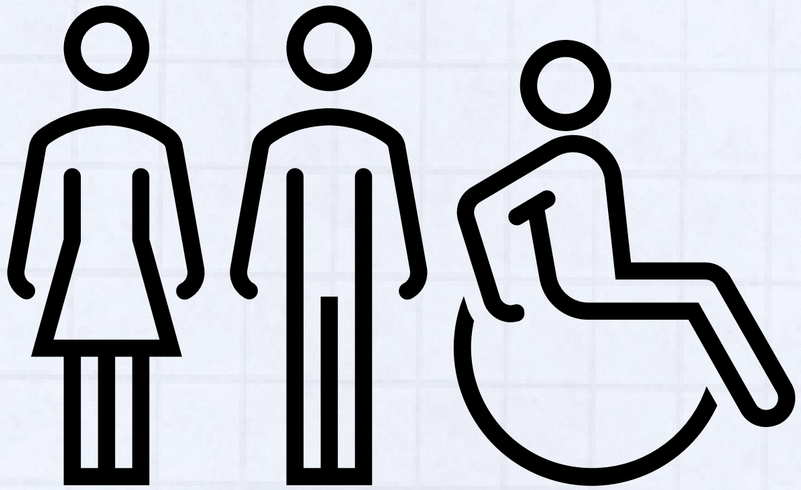
All classrooms are diverse!

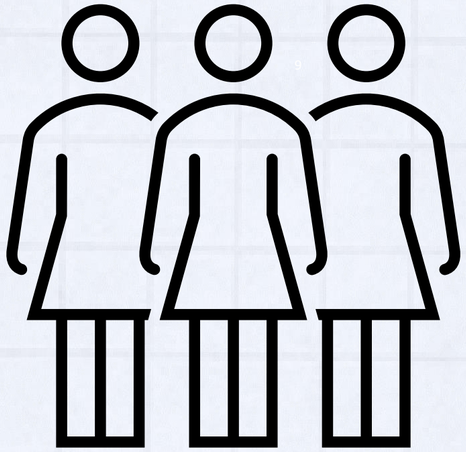
- Race/ethnicity
- Gender
- Socioeconomic background
- Religion
- Sexual orientation
- Political affiliation
- Upbringing (rural, suburban, urban)
- Education
- Nationality

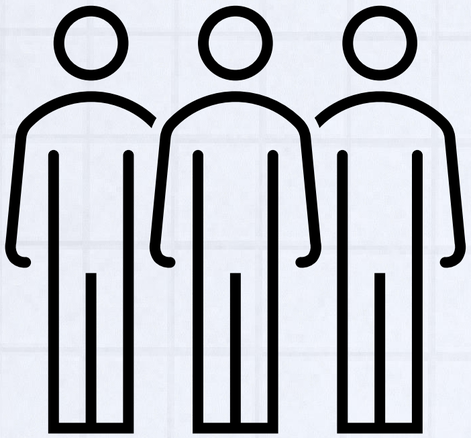
- Language/dialect
- Disability/ableness
- Assumptions/biases
- Knowledge
- Dispositions
- Values
- Beliefs
- Etc.

Inclusion









Education for All Children Act, or Public Law 94-142.

Inclusive Practices

Funds of Knowledge

Culturally Congruent Instruction

Culturally Responsive Pedagogy

Culturally Sustaining Pedagogy

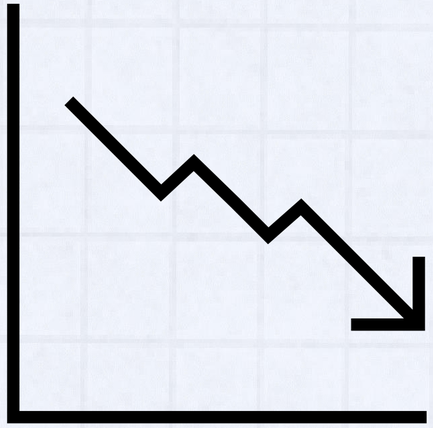
Culturally Relevant Pedagogy

Third Space

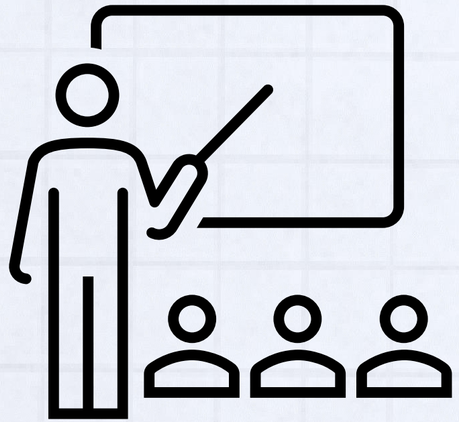
Mensah, F.M., & Larson, K. (2018). A summary of inclusive pedagogies for science education grades 6-12. National Academy of Sciences. [Commissioned]

Inclusion is for mathematics and science because…

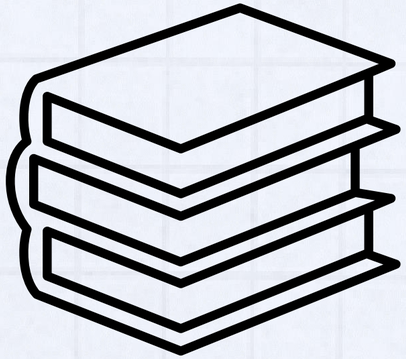
The data/research tell us.



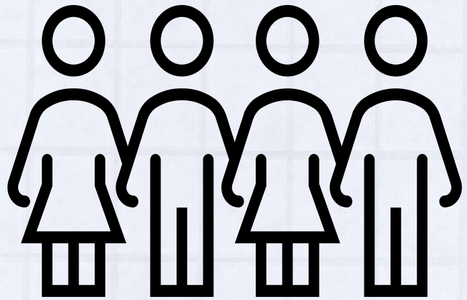
The pedagogy tells us.



The curriculum tells us.



The children tell us.



Science Timelines (K12-College)

"I ended up dropping out of chemistry and getting very low scores in biology. I hated how my passion was stifled because of how unrelatable and uninterestingly science was taught in the higher education college setting. I therefore quit and delved into something that could not be decontextualized- education."

"When I went to college I only had to take one science course. I decided to take astronomy thinking I would learn about horoscopes. All I learned was that Astronomy is not about one's horoscope. The class was so boring. I would find myself dozing off."

"I was required to take 2 semesters of science in college. My first year, I took Biology with a lab. I dreaded going to this class. I did not understand the content. I was always confused in lab."

Fig. 1 | The hostile obstacle course that women and BIPOC researchers have to endure in STEMM. Illustration inspired (with permission) by Emanu's Equality hurdles[38]. Credit: Mvmet.

A Hostile Obstacle Course (STEMM)

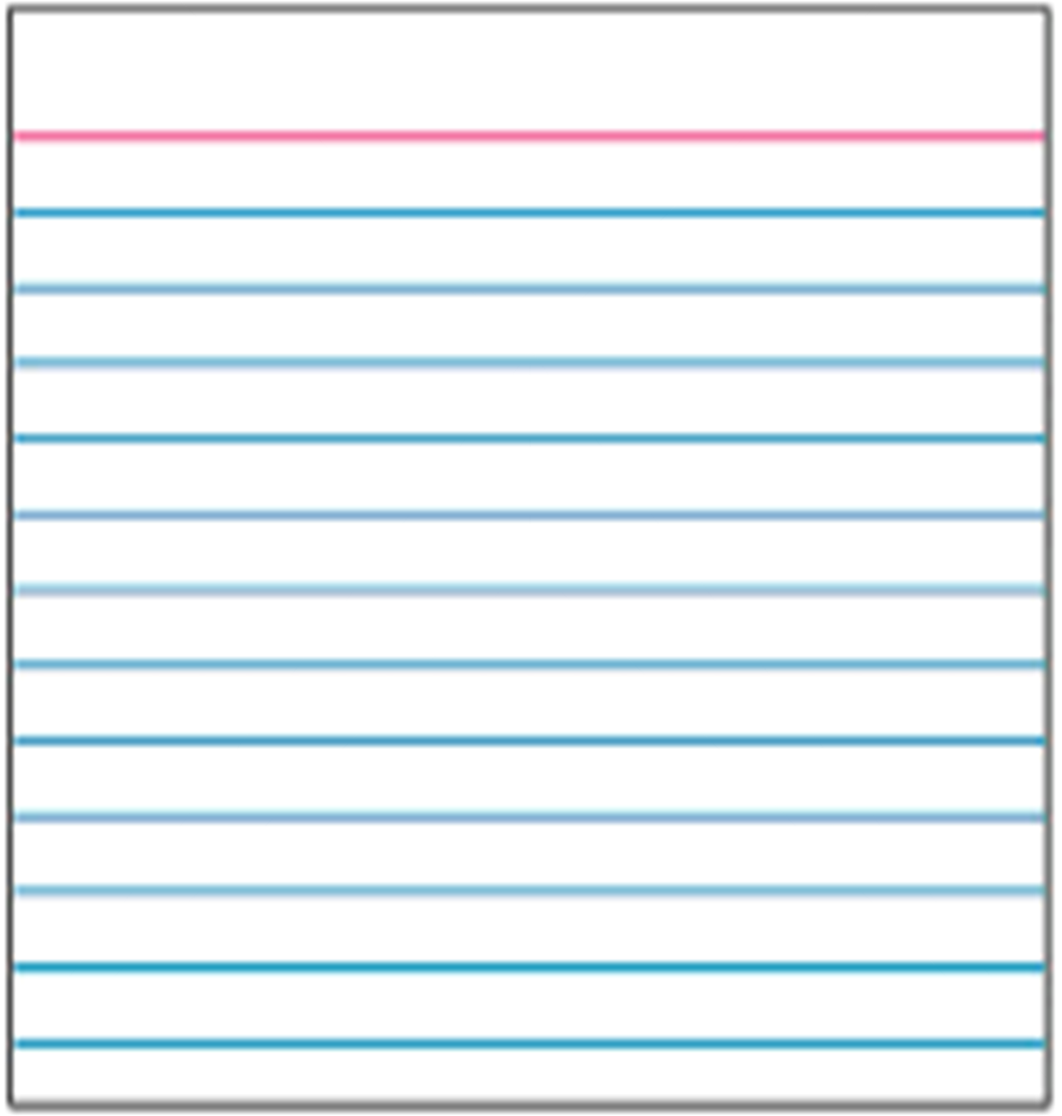
"What's the matter?
It's the same distance!"

Berhe, A.A., Barnes, R.T., Hastings, M.G. *et al.* Scientists from historically excluded groups face a hostile obstacle course. *Nat. Geosci.* **15**, 2–4 (2022). https://doi.org/10.1038/s41561-021-00868-0

Self-Assessment

What do we say & do that may hinder inclusion?

Review & Reflect



A Need for Inclusive Teaching

SUPERFICIALITY
"Get to know your students."

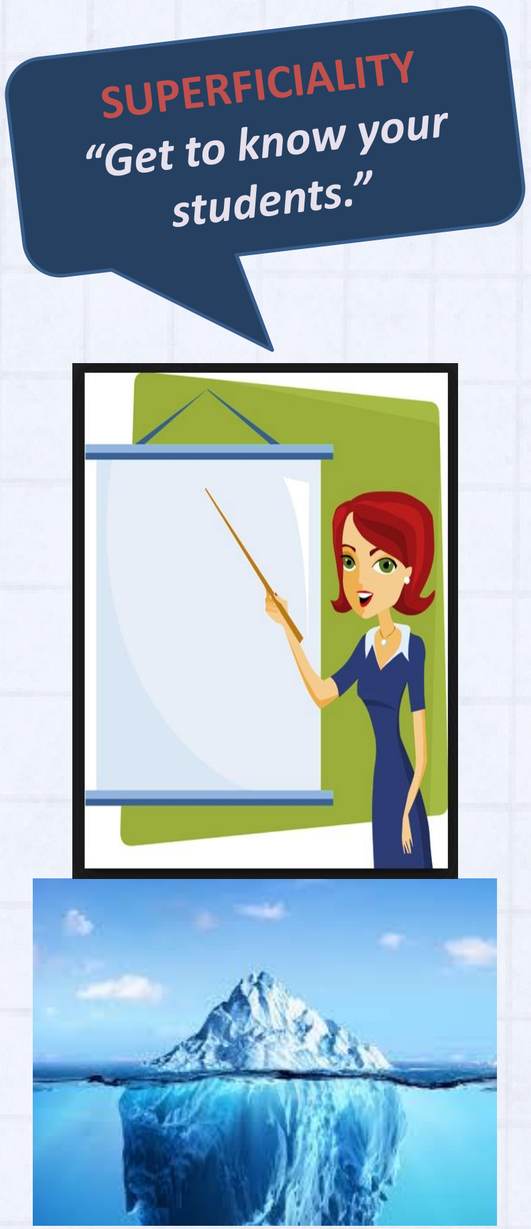
COLORBLINDNESS
"I don't see color. I treat all my students the same."

DEFICIT CONCEPTIONS & INFERIORITY
"These students can't do this work."
"I feel sorry for her."

EQUALITY
"Give everyone the same thing."

MERITOCRACY
"You should try harder, or study more."

A Need for Inclusive Teaching



- Go deep, go under the surface ["homeplace" & "mattering"].
- Spend time getting to know who students are and what they think about STEM, learning, education, and goals.
- See students' talents and look at achievement and success in new ways.
- Allow students to express themselves in different ways.

- ***Do you have multiple, varying ways to get to know your students? And for them to get to know each other? And for them to get to know you?***
- ***Do you make assumptions about students (individuals or groups) based upon identities?***

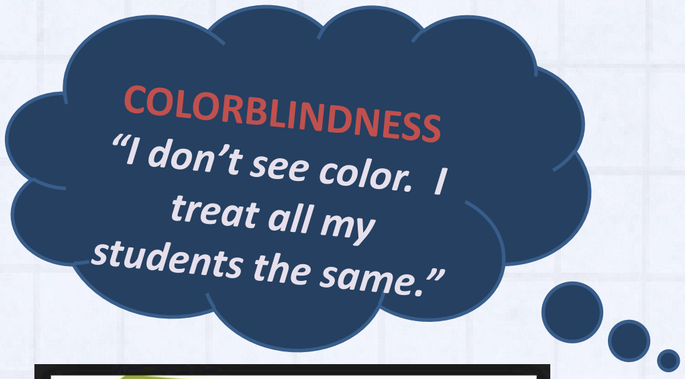
MERITOCRACY
"You should try harder, or study more."

A Need for Inclusive Teaching

- Students are rewarded based solely on their ability and performance; "the best and the brightest."
- Individual achievement; "unhealthy" competition.
- There are systemic and institutional barriers that hinder academic success (i.e., school & classroom policies practices).
- Not all students have the same opportunities for success.

- ***Who becomes the expert? Who gets chosen as the lab assistant, teaching assistant, or research assistant?***
- ***Is your course a weed-out course? Do you only teach "certain" courses? Is there racial, ethnic, and gender (etc.) diversity in your courses?***

A Need for Inclusive Teaching



- When we do not see our students as raced, gendered, classed, etc., we do not see their identities or the important role identities play in who our students are.
- We must take time to get to know our students' identities; intersectionality.
- Identity is connected to learning, and how students connect to the curriculum and content and us as instructors.

- ***Does your curriculum reflect students' intersectional identities, multi-literacies, multicultural knowledge, and values?***
- ***Do you include content, stories, and narratives not in the textbook? Are you included in the curriculum?***

A Need for Inclusive Teaching

DEFICIT CONCEPTIONS & INFERIORITY

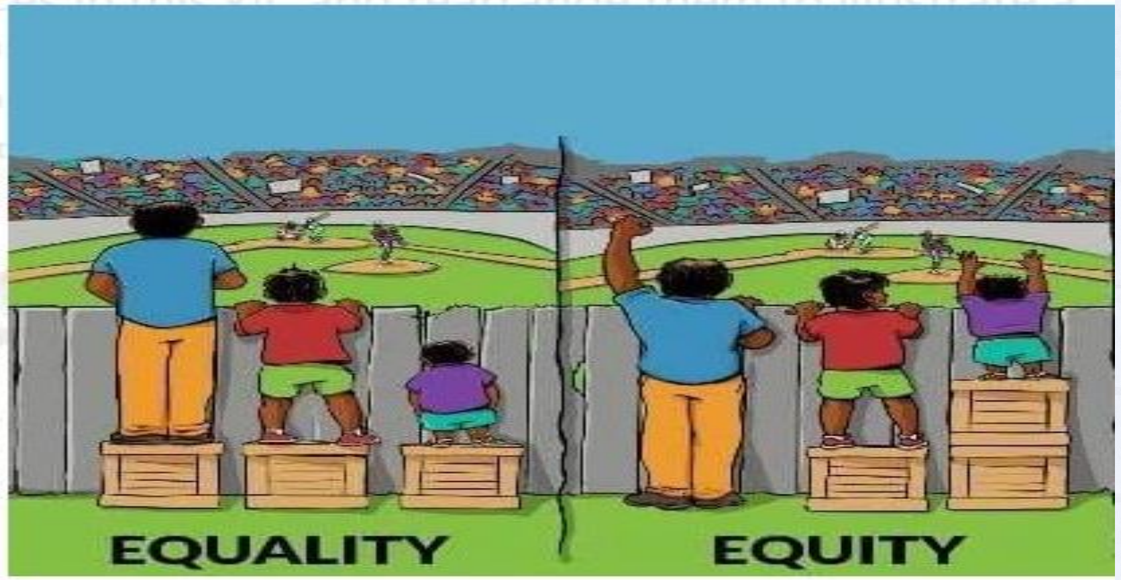
"These students can't do this work."

"I feel sorry for her."

- We must hold high expectations for all students and support them in getting there.
- Invite students to engage in the learning process with their assets and strengths in full display.
- Build on the knowledge and experiences students bring into the STEM classroom.
- We must see "thriving", and not failure, as an option for all students.

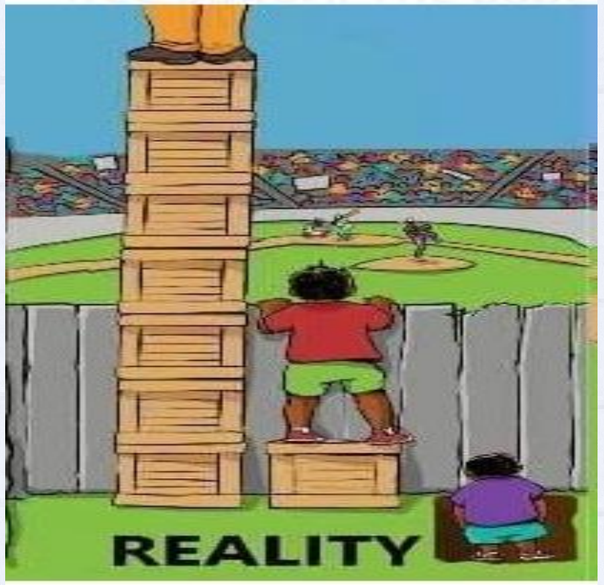
- ***Do you assist all students in being successful in your classroom? Are oppressive structures, barriers, obstacles dismantled?***
- ***Do you hold high expectations and provide supports for reaching high goals and standards?***

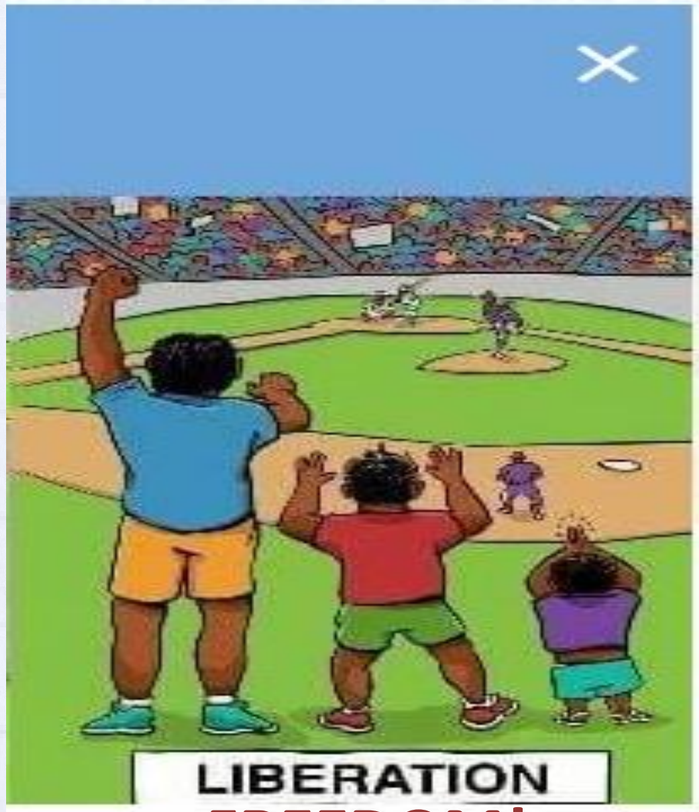
A Need for Inclusive Teaching



Delores Huerta Foundation

https://www.storybasedstrategy.org/blog/the4thbox





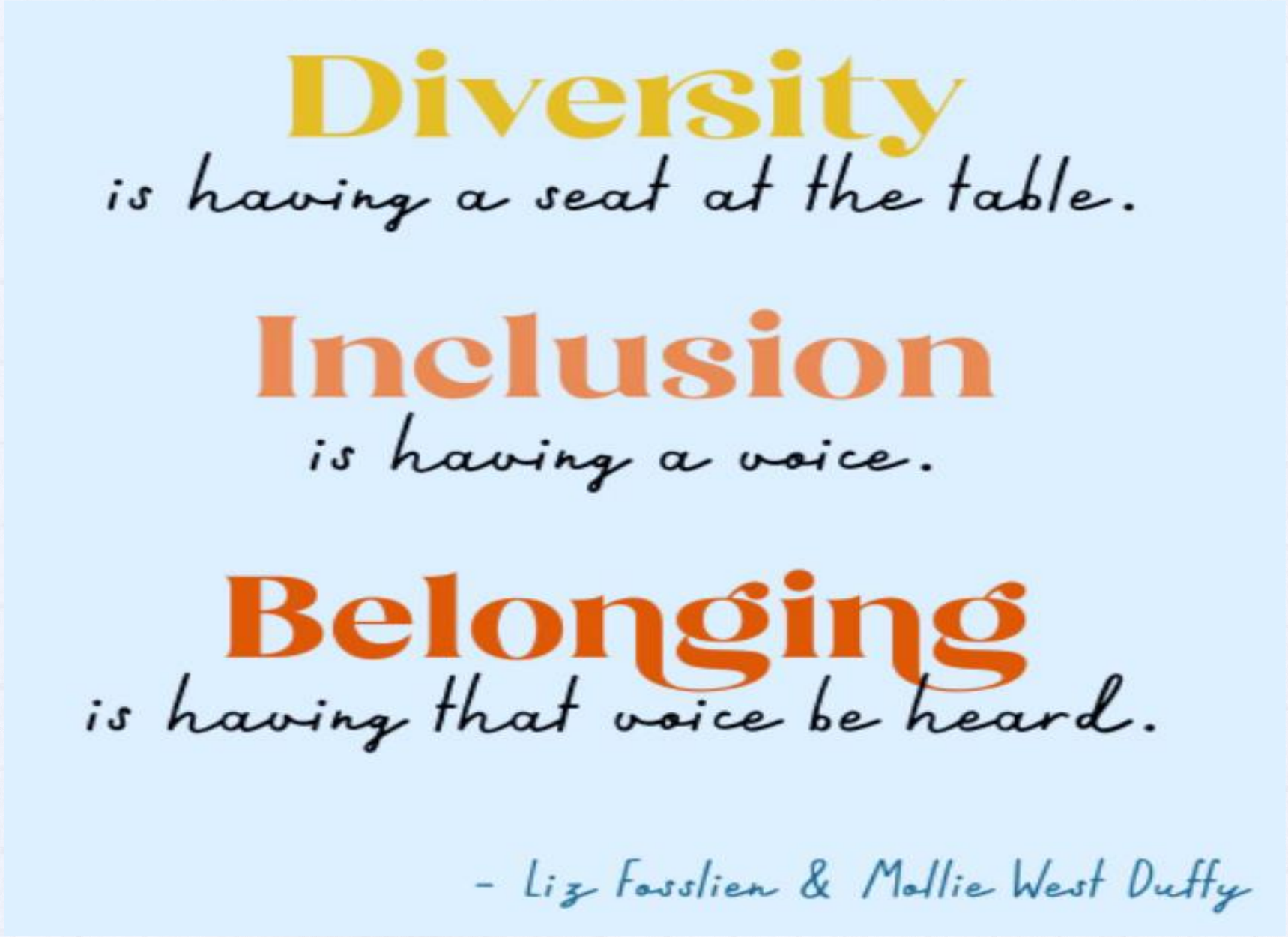
FREEDOM!

Equality is giving everyone the same thing.

Equity is giving them what they need.

Those who have get more; those who have less get resources taken away.

Let's tear down all barriers & obstacles that hinder diversity, equity, & inclusion for ALL!


Diversity
is having a seat at the table.
Inclusion
is having a voice.
Belonging
is having that voice be heard.
- Liz Fosslien & Mollie West Duffy

Inclusive STEM Teaching

"What are some examples?"

Inclusive STEM Teaching

Study STEM in its socio-cultural, socio-historical, and socio-political contexts

- These “socio’s” are embedded through and in examples of scientists and mathematicians in how they do their work; consider the culture of science and the culture of mathematics.
- It is embedded in the kinds of questions that are asked, as well as the approaches taken to solve problems.
- It is embedded in the lives and histories of scientists in what they call science, and how they interpreted their results. Their culture, experiences, and diversities helped to make breakthroughs in STEM.
- Students learn about the content, knowledge, skills & practices that emerge as STEM from diverse perspectives.

Objectivity & Subjectivity

Inclusive STEM Teaching

Study STEM in its socio-cultural, socio-historical, and socio-political contexts

Cultural Ways of Knowing

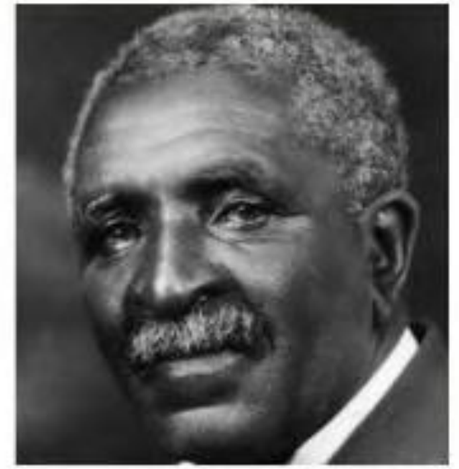
- US college students and Indigenous Panamanian Ngäbe adults look at illustrations from a children's book on coyote and badger hunting.
- The US college students interpreted the relationship as competitive, while the Ngäbe adults viewed it as cooperative.

- Wildlife biologists initially hypothesized that coyotes and badgers hunting in the same area were competing for prey. After further observation, they realized the badgers and coyotes were hunting cooperatively.
- Cultural orientations produce different interpretations of observations– Prey/Predator vs. Cooperative/Communal

Bang, M., Marin, A., & Medin, D. (2018). If Indigenous peoples stand with the sciences, will scientists stand with us?. *Daedalus*, *147*(2), 148-159.

Inclusive STEM Teaching

Study STEM in its socio-cultural, socio-historical, and socio-political contexts



Contributions of Black Scientists & Mathematicians

George Washington Carver-- ideas about planting (peanuts) changed the way scientists viewed the purpose of soil; he had more than 300 different products derived from the peanut, some 100 from sweet potatoes, about 75 from pecans, and many more, including crop rotation.

- Discrimination race/ethnicity; mobile lab; artist, musician
- Biography (LINK)

Inclusive STEM Teaching

Study STEM in its socio-cultural, socio-historical, and socio-political contexts

Contributions of STEM Women

Barbara McClintock-- inquiries of corn/maize (mutations) changed the way scientists approached scientific methods; jumping genes (not stationary)

- Discrimination/gender bias; not being accepted
- Biographical Overview (LINK)

Hidden Figures-- Three brilliant African American women at NASA (Katherine Johnson, Dorothy Vaughan, and Mary Jackson, and the "Computers."

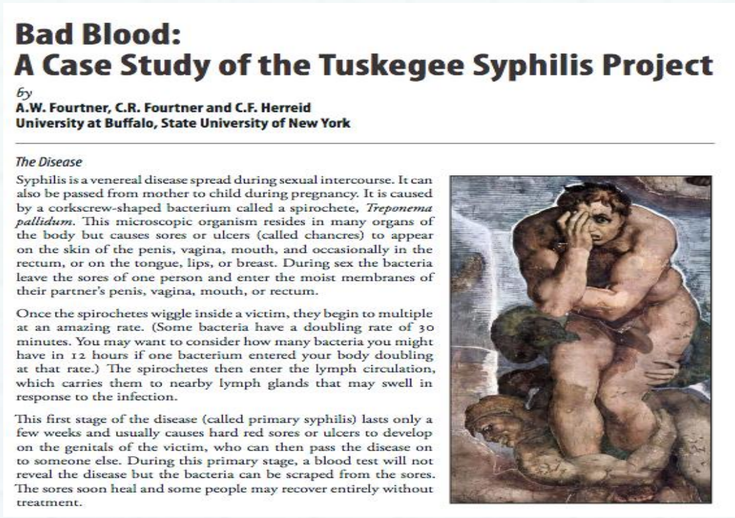
- Discrimination/gender & racial bias; not being accepted
- True Story of Hidden Figures (LINK)

Inclusive STEM Teaching

Study STEM in its socio-cultural, socio-historical, and socio-political contexts

The Tuskegee Experiments

- The ethics of human experimentation can be studied from the infamous syphilis studies performed at the Tuskegee Institute from the 1930s to the 1960s.
- Sponsored by the U.S. Public Health Service, 399 African American men with syphilis were recruited for a research study on the progression of the disease when left untreated.


Bad Blood:
A Case Study of the Tuskegee Syphilis Project

by
A.W. Fourtner, C.R. Fourtner and C.F. Herreid
University at Buffalo, State University of New York

The Disease

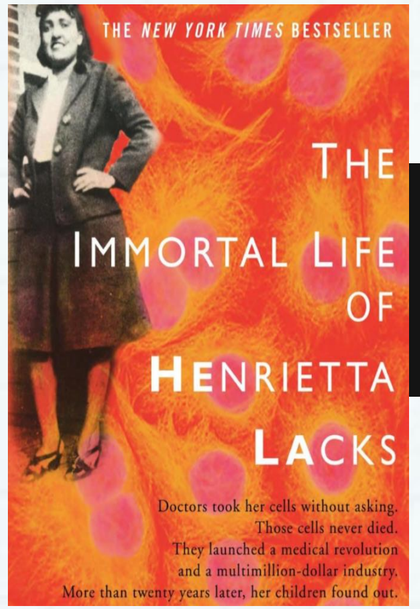
Syphilis is a venereal disease spread during sexual intercourse. It can also be passed from mother to child during pregnancy. It is caused by a corkscrew-shaped bacterium called a spirochete, *Treponema pallidum*. This microscopic organism resides in many organs of the body but causes sores or ulcers (called chancres) to appear on the skin of the penis, vagina, mouth, and occasionally in the rectum, or on the tongue, lips, or breast. During sex the bacteria leave the sores of one person and enter the moist membranes of their partner's penis, vagina, mouth, or rectum.

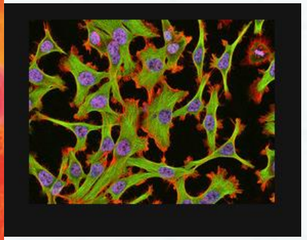
Once the spirochetes wiggle inside a victim, they begin to multiple at an amazing rate. (Some bacteria have a doubling rate of 30 minutes. You may want to consider how many bacteria you might have in 12 hours if one bacterium entered your body doubling at that rate.) The spirochetes then enter the lymph circulation, which carries them to nearby lymph glands that may swell in response to the infection.

This first stage of the disease (called primary syphilis) lasts only a few weeks and usually causes hard red sores or ulcers to develop on the genitals of the victim, who can then pass the disease on to someone else. During this primary stage, a blood test will not reveal the disease but the bacteria can be scraped from the sores. The sores soon heal and some people may recover entirely without treatment.

The HeLa Cells

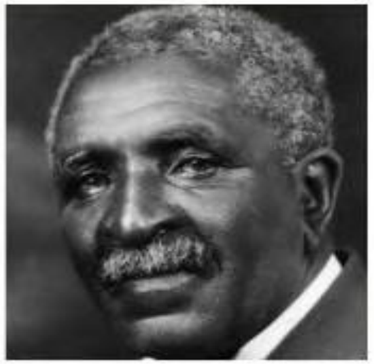
- Henrietta Lacks, a poor Black tobacco farmer whose cells were taken without consent.
- Important in developing polio vaccine, cloning, gene mapping, and more.

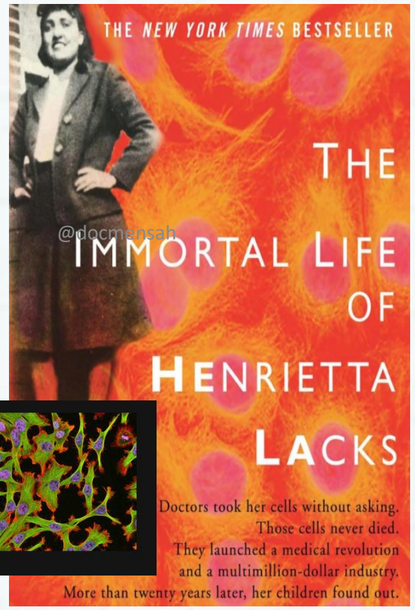


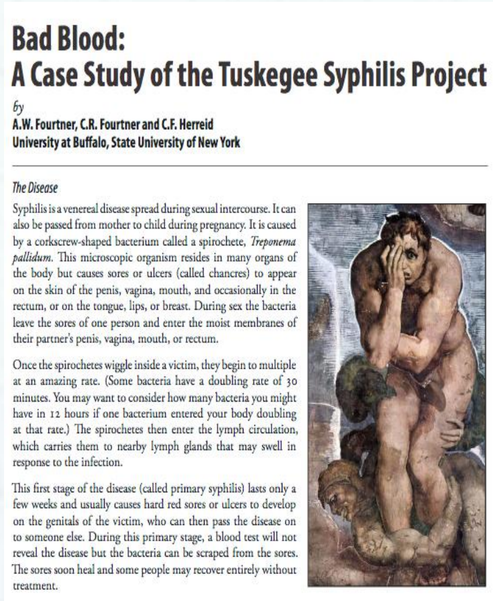


Interdisciplinary STEM Connections

- Students can study the science underlying the Tuskegee experiments & HeLa cells as well as the ethical, human rights, social, racial, and gender issues of these two cases.
- Students can understand the evolution in our thinking on issues of science, human experimentation, and race, and how these topics are influenced by our culture, society and times.
- Students can study treatment and medicines used then and now.
- Students can use data, create data tables, graphs, and make calculations.







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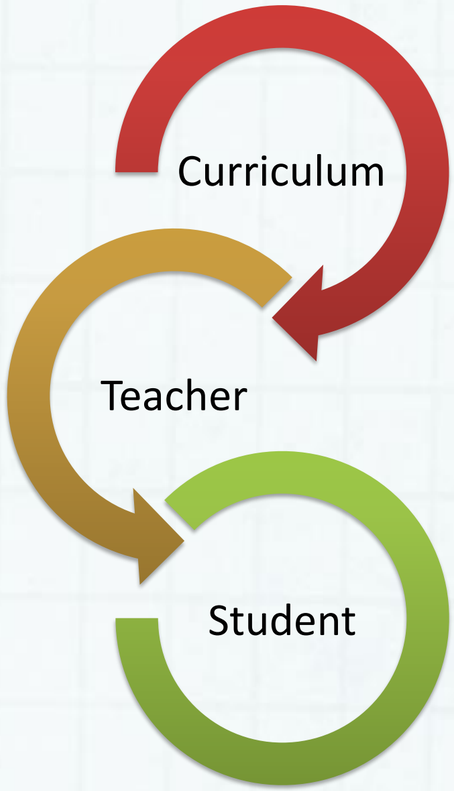
Review & Reflect

Summary

Inclusive Teaching = Good Teaching



Use your knowledge about students' lives to design **student-centered instruction** that builds on what they already know while stretching them beyond the familiar.

- Invite diverse perspectives & applications from readings & students' experiences
- Have open expression of ideas welcomed and critiqued
- Use a variety of instructional tools, methods & assessment strategies

Summary

Inclusive Teaching = Good Teaching

Additional Resources

iNaturalist

LEARNING FOR JUSTICE

NAE GRAND CHALLENGES FOR ENGINEERING
NATIONAL ACADEMY OF ENGINEERING

Our World in Data
Articles by topic

ABOLITIONIST TEACHING NETWORK

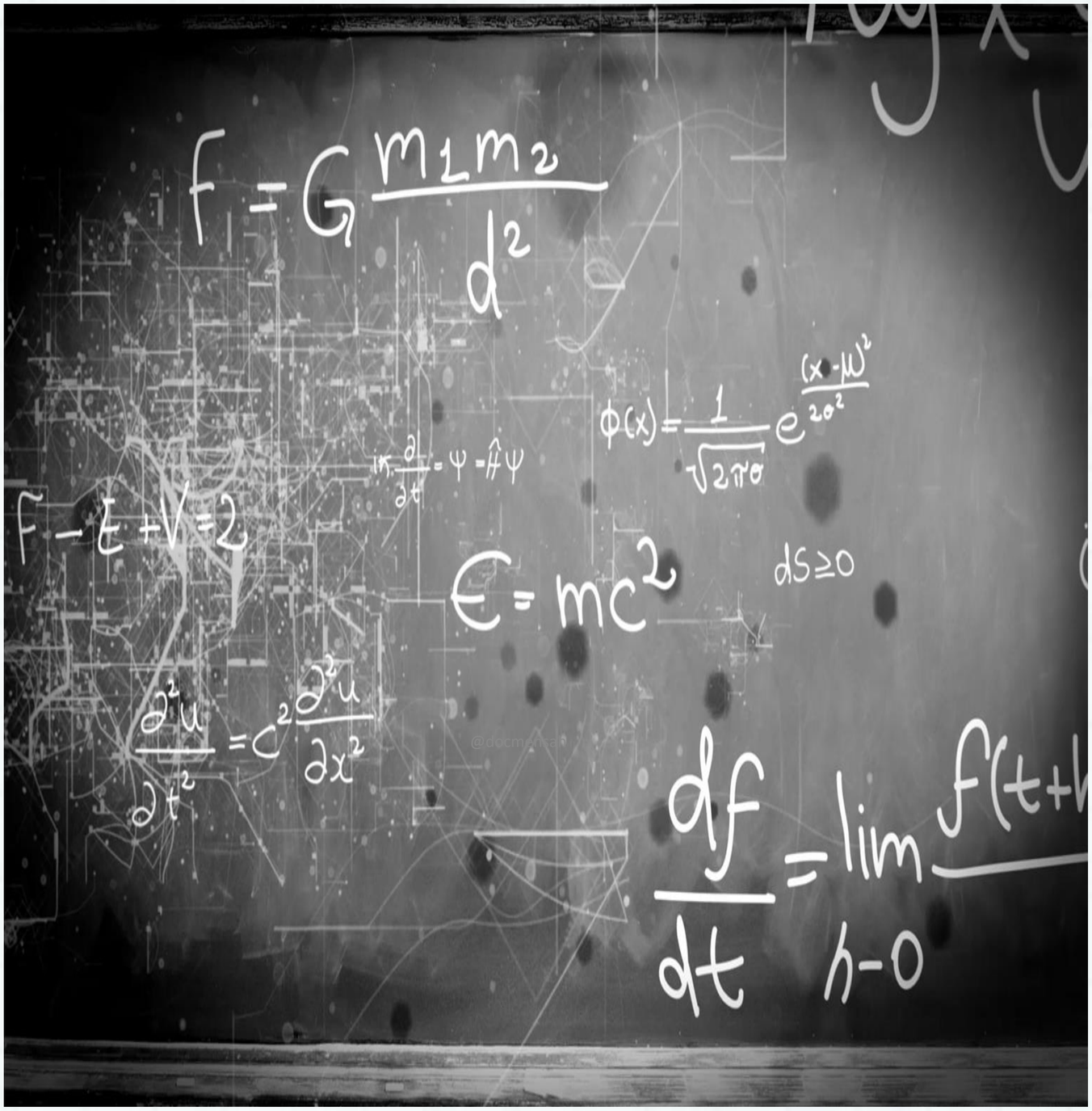
STEM teaching tools

...1700 1620 1975 2003 NOW
BlackFacts.com
Learn Black History. Teach Black History

nsta
National Science Teaching Association

TOOLS FOR AMBITIOUS SCIENCE TEACHING

NextGenScience
WestEd



THANK YOU!

I Didn't Know Inclusion Was For Science and Mathematics, Too

Felicia Moore Mensah, PhD

@docmensah | fm2140@tc.columbia.edu

Teachers College, Columbia University