

# Revolutionizing Engineering Curriculum and Culture: Tips for Addressing Inclusivity, Diversity and Sustainability



**Department of Civil and Environmental Engineering**

**Dr. Kauser Jahan, PE**

**Professor and Head**

[jahan@rowan.edu](mailto:jahan@rowan.edu)

 **Rowan University**

HENRY M. ROWAN  
COLLEGE OF ENGINEERING





# CEE CURRICULAR CHANGES

## A purposeful shift to Inclusion & Diversity

In support of the 2020 Strategy, Clorox has refreshed its Inclusion & Diversity (I&D) strategy.

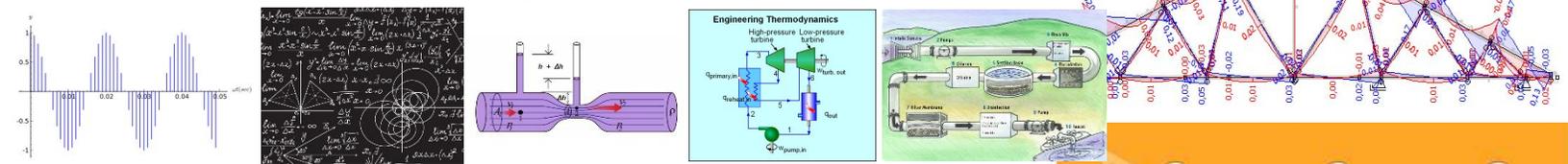
What we and other companies have learned is that diversity can't thrive without inclusion.



Clorox is broadening its understanding of diversity to include attributes that can't be seen at first glance, including ethnicity, thinking styles and experiences.



Statistics that Prove the Value of Diversity in the Workplace

Humanities

history, language, digital, poetry, philosophy, art, problem-solving, culture, community, engage, creative, media, ideas, conversation, brainstorm, criticism, thoughtful, change, justice, ethics, impact, understanding, collaborative, management, analysis, blogs, literature, explore, initiative, knowledge, art, problem-solving, culture, community, engage, creative, media, ideas, conversation, brainstorm, criticism, thoughtful, change, justice, ethics, impact, understanding, collaborative, management, analysis, blogs, literature, explore, initiative, knowledge

$A^2 + B^2 = C^2$

MATH

CAN HELP YOU UNDERSTAND THE PYTHAGOREAN THEOREM

HUMANITIES

CAN HELP YOU UNDERSTAND

2B OR NOT 2B

SCIENCE CAN TELL YOU HOW TO CLONE A TYRANNOSAURUS REX



HUMANITIES CAN TELL YOU WHY THIS MIGHT BE A BAD IDEA

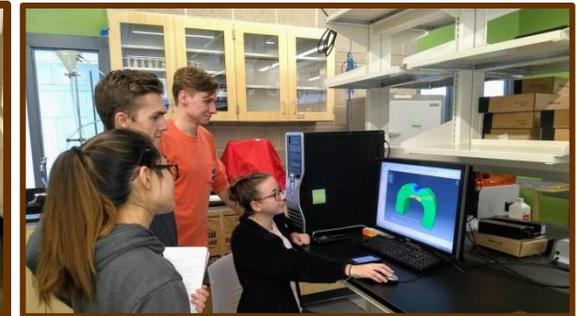
The CEE department at Rowan University emphasizes TLC: Teamwork, Leadership, & Community.

Our goal is to develop leaders with technical competence to build a sustainable world. We strive to prepare students who are poised to meet the challenges facing the world today and tomorrow.

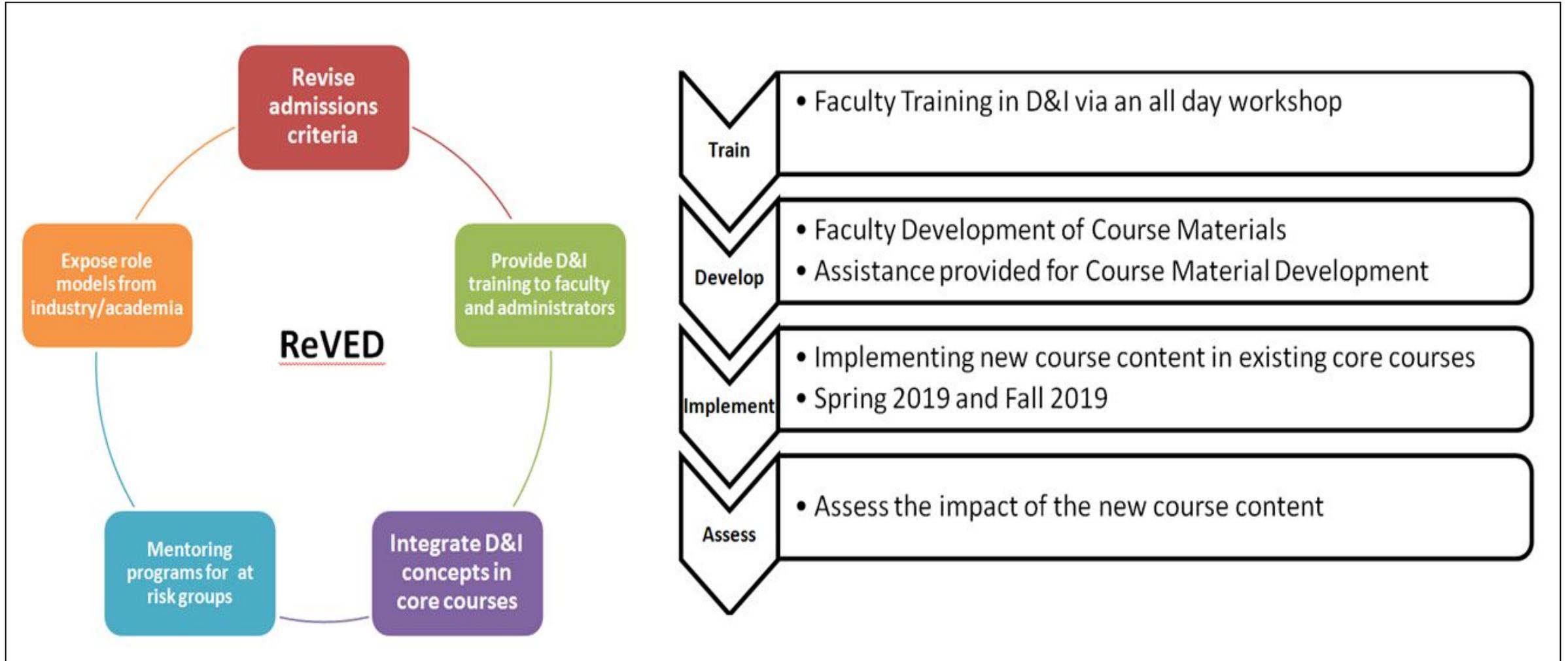
- Structural Engineering
- Transportation Engineering
- Geotechnical Engineering
- Mechanics and Materials
- Resiliency Planning for Communities
- Environmental Engineering
- Water Resources Engineering
- Sustainable Facilities
- **Innovative Curriculum**
- **STEM Outreach**

Total Research  
Funding

Fall 2018  
**\$10 Million**

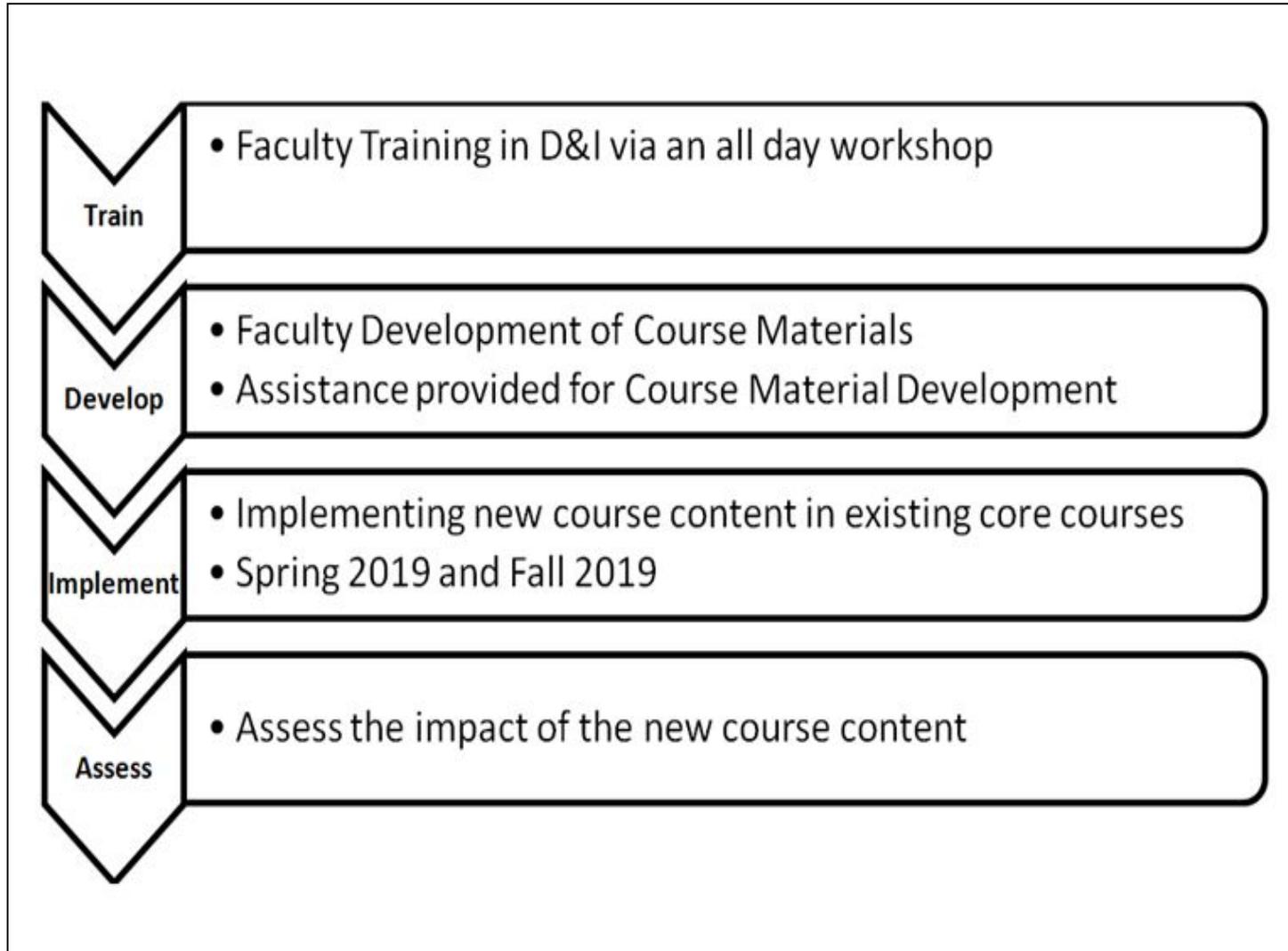


# MULTI - PRONG APPROACH TO DEI (Diversity, Equity and Inclusivity)



# FACULTY DEVELOPMENT

## DEPARTMENT



## UNIVERSITY

**TRANSFER STUDENT  
PIPELINES**

**DEI OFFICE**

**FACULTY  
DEI  
CERTIFICATE**

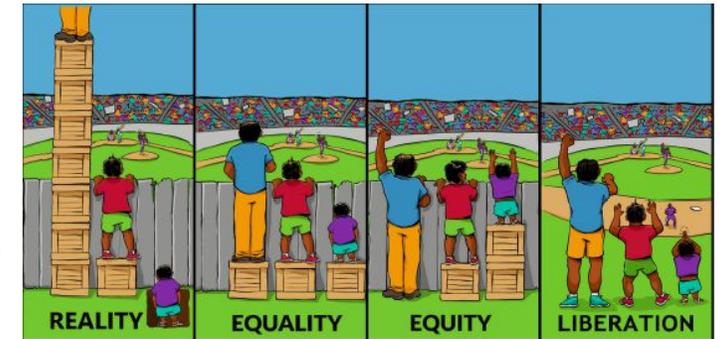
**FACULTY CENTER  
INCLUSIVE PEDAGOGY  
CERTIFICATE**

**TNR CRITERIA  
OFFER LETTERS**

**PIPER GRANTS**

# CHANGE DEPARTMENT CLIMATE/CULTURE

- Department statement on diversity and inclusion (Posted on webpage)
- Faculty workshops on Diversity Equity Inclusivity
- Faculty required to get a DEI certificate and Inclusive Pedagogy certificate
- Provide faculty support to make their curricular changes-such as a paid student from department
- An agenda item at every department meeting and send of semester reflection
- Integrate DEI, ethics in all courses and try to distribute evenly across the semester
- Course evaluations-add questions on diversity
- Verbiage in tenure & promotion criteria
- Department webpages
- Value research that embraces teaching pedagogy, inclusivity, diversity
- Setup posters/images that embrace inclusivity and diversity
- Celebrate diversity & inclusivity by dedicating a time for celebration-global food dishes, posters
- Explain EQUITY via a visual
- Recruit students/faculty from diverse backgrounds
- **USE SOCIAL MEDIA to highlight your core values**



# CURRICULAR CHANGES

1990-2010

- How do students learn?- Visual, Sequential, Confluent
- Demonstrations/Hands-on
- Integrate sustainable/green/DFE engineering
- Global and societal context
- Ethics
- **Inclusivity & Diversity &Equity**
- **Biases- gender/racial/sexual orientation**

- Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such **as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability**
- **(f) an understanding of professional and ethical responsibility**
- **(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context**
- **(i) a recognition of the need for, and an ability to engage in life-long learning**
- **(j) a knowledge of contemporary issues**

Employers recognize the value of inclusivity and diversity. All companies nowadays have policy and address ID.

Employers seek students from diverse backgrounds.

Employers see employees who value and understand need for ID.

# INCLUSIVE STRATEGIES FOR COURSES

STRATEGY	
Syllabus Rewording	Required
Reword technical problem wording	Required
PowerPoint Presentations on case studies	Required
Assign a team project (report, presentation, video, brochure)	Required
Assign team names based on people of influence or the team adopts a country	Encouraged
Assign teams to watch a movie that focuses on diversity, social injustices, ethic violations, gender biases	Encouraged
Add questions on quizzes/exams	Encouraged
Test students in different ways (Take home, Team assignment, Open book)	Encouraged
Field Trip	Encouraged
Extra credit- Diversity and Equity issues	Encouraged
Extra Credit- Appreciation for the arts from various cultures	Encouraged

# SIMPLE STEPS

Demonstrate that diversity and inclusivity is important to you by casually blending these topics in your day to day lectures instead of dedicating one lecture in the semester to the topics

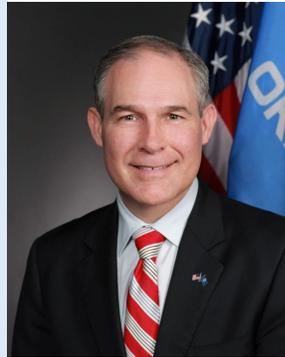
- Syllabus
- Assign a team project
- Team names based on people of influence or the team adopts a country
- Assign movies that are relevant (not only technical aspects), gender/race issues
- Reword your questions
- Add questions on quizzes/exams
- Test students in different ways
- Extra credit- Diversity issues
- Reward – Diversity Awards



Vandana Shiva



Wangari Muta



Scott Pruitt

## First Year Engineering Clinic Unit Conversion

3 .Spirulina (a blue-green algae) is a remarkable source of nutrients, containing the highest natural source of complete proteins, omega fatty acids, iron, and antioxidants. The health applications of a superfood like spirulina can translate across countless circumstances, from saving lives in the Central African Republic to providing everyday nutrients to anyone around the world. The St. Joseph Health Centre in Bangui, a Central African Republic, grow their own algae as a supplement for malnourished children who have suffered the ravages of war since 2013.



The following information is available:

The protein content of Spirulina is 6 grams of protein/gram of Spirulina.

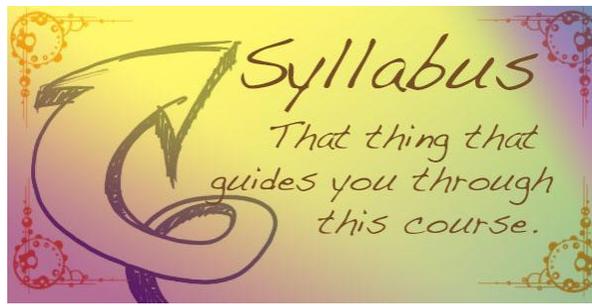
Daily Protein Needs: 1.5 g protein for every 2lbs of body weight for children aged 2-8 years.

Average weight of impoverished 2-8 year olds in Bangui ~ 17 lbs

# of malnourished children in Bangui/year ~ 10,000

- a) How many tons of Spirulina will be needed annually to provide adequate protein to the children of Bangui?
- b) The protein content of peanut butter is 0.25 gram/ gram of peanut butter. A food manufacturing wants to enrich the protein content of its existing peanut butter bar weighing 50 g.
  1. What is the current protein content of the bar in grams?
  2. If 5 grams of spirulina to the existing bar, what will be the new protein content in grams per bar?

# SYLLABUS



Make your syllabus fun and interactive.

## *STATEMENT ON DIVERSITY & INCLUSION*

I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. If you feel that your contribution is not being valued for any reason, please speak with me privately. If you wish to communicate anonymously you may do so in writing or speak with the Office of Social Justice, Inclusion, Conflict Resolution ([socialjustice@rowan.edu](mailto:socialjustice@rowan.edu), 856-256-5496, Room 118, Robinson Hall).

## *LIVED NAME POLICY*

The name by which a person wishes to be known and to have appear in University systems and when conducting day-to-day University business because it affirms that individual's gender, culture and other aspects of social identity. The preferred name will consist of a preferred first name, and preferred middle name when provided. The preferred name does not affect the individual's last name, which must remain the person's legal name.

## *ACCOMODATION*

Your academic success is important. If you have a documented disability that may have an impact upon your work in this class, please contact me. Students must provide documentation of their disability to the Academic Success Center to receive official University services and accommodations. The Academic Success Center can be reached at 856-256-4234. The Center is located on the 3rd floor of Savitz Hall. The staff is available to answer questions regarding accommodations or assist you in your pursuit of accommodations. We look forward to working with you to meet your learning goals.

*Your job is not done if you just add language to the syllabus. Your contributions in the classroom need to influence students so they understand that these issues are important in engineering and also important to you. Actions speak louder than words!*



# FAMOUS FIGURES IN MATH

- Hypatia (370-415) Hypatia is the first **woman** known to have taught mathematics. ...
- Sophie Germain (1776-1831) ...
- Ada Lovelace (1815-1852) ...
- Sofia Kovalevskaya (1850-1891) ...
- Emmy Noether (1882-1935) ...
- Dorothy Vaughan (1910-2008) ...
- Katherine Johnson (born 1918)
- Julia Robinson (1919-1985)
- Mary Jackson (1921-2005)
- Maryam Mirzakhani (1977-2017)

**Mary Jackson (1921-2005)**

*"We have to do something like this [helping students build wind tunnels and conduct experiments] to get them interested in science. Sometimes they are not aware of the number of black scientists, and don't even know of the career opportunities until it is too late."*

- Earned a dual degree in mathematics and physical sciences
- Petitioned to take graduate courses so she could work on Supersonic Pressure Tunnel project at NASA's predecessor
- Became NASA's first black female engineer and co-authored 12 technical papers at the agency
- Accepted a demotion to become a manager, allowing her to help women and other minorities in their careers at NASA

**Maryam Mirzakhani (1977-2017)**

*"The beauty of mathematics only shows itself to more patient followers."*

- In high school, she along with her best friend became the only Iranian women to qualify for the International Mathematical Olympiad
- Published three separate papers for top mathematical journals from her Ph.D. thesis alone
- Studied several branches of theoretical mathematics, and offered a new proof for the Witten conjecture for the International Mathematical Olympiad
- Recognized as the only woman and Iranian to receive the Fields Medal, the most prestigious award in mathematics

**Hypatia (370-415)**

*"There were no women at Alexandria's greatest Hypatia, daughter of the philosopher Thales, who made such advances in astronomy and sciences as to be recognized by the philosophers of her own time."*

- Believed to be the first woman to teach mathematics
- Collaborated with her father on commentaries of various mathematical works
- Wrote several works to help her students grasp mathematical concepts
- Regarded as an accomplished astronomer and Neoplatonic philosopher

**Sophie Germain (1776-1831)**

*"Algebra is but written geometry, and geometry is but figured algebra."*

- Taught herself advanced mathematical topics, Latin, and French on her own
- Used the name of a male father to gain the attention of a professor
- Earned a doctorate in Paris's last Theorem, enabling her to publish her work
- The second black woman to be elected to the French Academy of Sciences

**Ada Lovelace (1815-1852)**

*"The more I study, the more desirable do I find my genius for it to be."*

- Was the only woman to become a mathematician and scientist
- He worked on the first computer to recognize the potential of a machine thinking
- Developed a computer-based algorithm, making her the first computer programmer

**Sofia Kovalevskaya (1850-1891)**

*"It is impossible to be a mathematician without being a poet in soul."*

- Proposed a new method to solve hypergeometric series
- Became the first woman to receive a Ph.D. in mathematics
- Became the first woman to receive the Fields Medal, the most prestigious award in mathematics

**Emmy Noether (1882-1935)**

*"My methods are really methods of working out thinking; this is why they have crept in everywhere unannounced."*

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**Dorothy Vaughan (1910-2008)**

*"I changed what I could, and what I couldn't, I endured."*

- Taught high school in a segregated school in Virginia
- Worked on a computer project at NASA's predecessor
- Became the first black woman to be elected to the French Academy of Sciences

**Katherine Johnson (born 1918)**

*"Girls are capable of doing everything men are capable of doing. Sometimes they have more imagination than men."*

- Inspired professor W.V. Strehl to help her get into graduate school
- Performed trajectory analysis at NASA for Alan Shepard, the first American in outer space
- Checked computer's orbital calculations for John Glenn's mission
- Received the Presidential Medal of Freedom in 2003

**Julia Robinson (1919-1985)**

*"I like to think of mathematics as a form of art, a way of seeing things, and I believe that it is the most beautiful of the arts and sciences."*

- Completed grade 5 in an year after missing two years of school due to illness
- Became more devoted to mathematics in college
- Worked for decades on an error after missing two years of school due to illness
- Contributed to solving problems in group theory and statistics

**Mary Jackson (1921-2005)**

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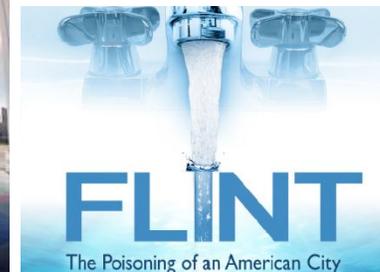
# MOVIES

Assign teams to watch a movie/documentary-not all need to be on a technical contribution.

- **Legally Blonde- Good message- you can be blonde, beautiful and like pink and be smart!**
- **Whale Rider – Society wants women to prove themselves before they can be picked as a leader**
- **Rosalind Franklin: The Dark Lady of DNA- struggled with lack of confidence-a very human trait in our students**
- **Stephanie Kwolek – Confident about her knowledge**
- **Bhopal Express – How India forced Union Carbide to change laws in the USA for People Right to Know !**
- **Erin Brockovich – Her curiosity and compassion led to justice and the largest class action law suit. Still an activist to this day**
- **A Civil Action – John Travolta; movie based on real case**
- **The Imitation Game- Life of Alan Turing**



Stephanie Kwolek



# CHANGE LECTURE SLIDES

If you use lecture slides in your classes, add something that focuses on diversity and inclusivity

- Someone's major contribution that is not acknowledged much in literature
- An example from another part of the world or a contribution made by some civilization

**Disinfection**  
**Harriet Chick**  
**Chick's Law**



**Activated Carbon Structure**  
**Rosalind Franklin**



**Traffic Signal**  
**Garrett Morgan**



**Brooklyn Bridge**  
**Emily Roebling**



# REWORD QUESTIONS

- **Design a batch reactor with ...** > *A developing community needs to have access to safe drinking water. A batch reactor will serve their needs.*
- **A steel beam needs to be designed.....** > *The city of XX lost their “yy” structure due to Hurricane Sandy.*
- **Determine the shear force ...** > ***Bamboo was used for xx member.***  
*This was to address sustainable green engineering. Determine the shear force*
- **Calculate the alum dose .....** > *Alum is an universal coagulant and is used extensively in developing communities. Calculate the alum dose .....*

# REWARD STUDENTS AND FACULTY



*Introduce awards to recognize initiatives taken by faculty and students*

**Outstanding mentor award**- A CEE student who is active in mentoring others to be successful in STEM

**Humanitarian award** – A CEE student involved in outstanding humanitarian work

**Environmental Stewardship award** – Care and protection of the environment

**Diversity Champion Award** – A CEE student/faculty who champions diversity

**Outstanding service to the community award** - A CEE student who provides outstanding service to a community (local, national or international)

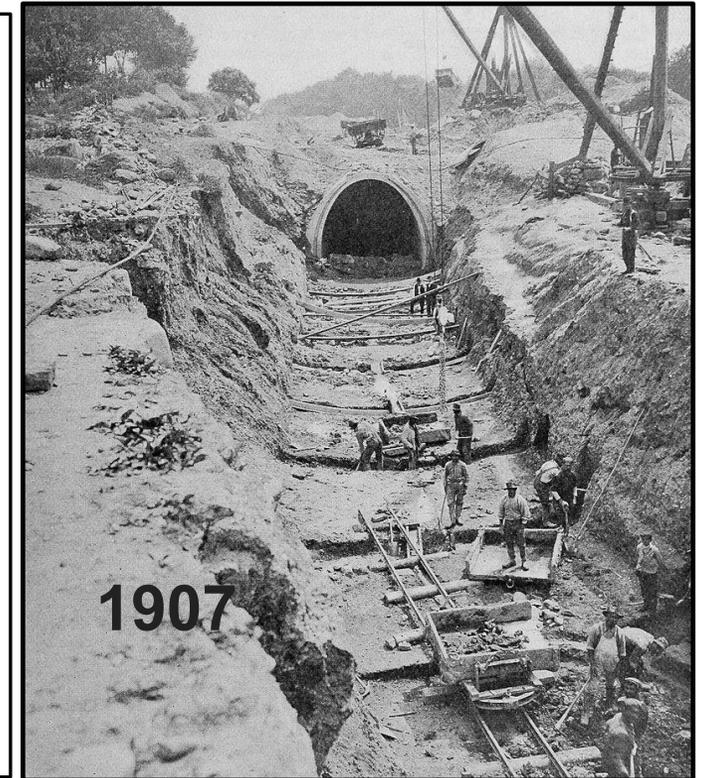
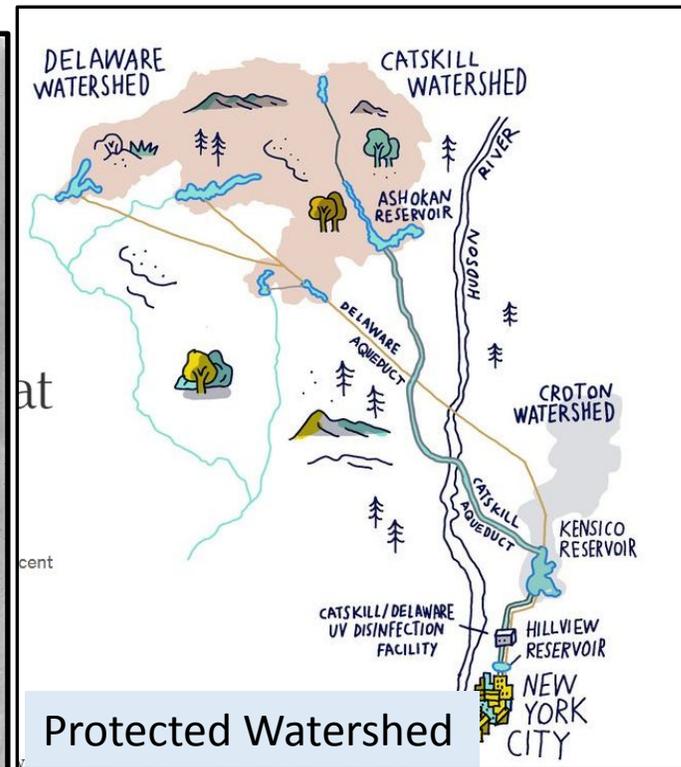
**Outstanding CEE Alumni Award** – A CEE alumni who has made outstanding contributions to the profession and to the community

**Outstanding service to the CEE department award** – A CEE student (s) who demonstrate (s) outstanding service to the CEE department



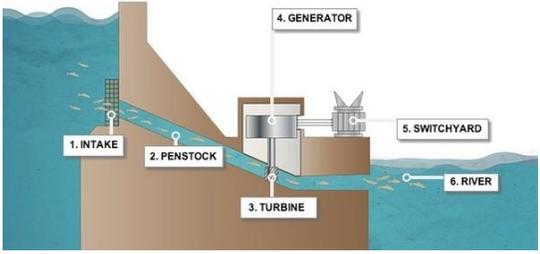
# FLOW THROUGH PIPES

- Drinking water for New York City
- Pristine water quality
- Engineering marvel
- **Water distribution impacts gender in poor communities**



# HYDRAULICS (DAMS)

- ELWHA DAM
- HETCH HETCHY



- Ethics
- Social Injustices
- Racial Injustices
- Ecosystem
- Fighting for a Cause
  - John Muir



**Klallam Tribe  
Chinook Salmon**



Map of Washington state showing the location of the Elwha Dam and Glines Canyon Dam. The map labels the Strait of Juan de Fuca, Salish Sea, Elwha River, Elwha Dam, and Glines Canyon Dam. The Pacific Ocean is also labeled.



# Water for the Alhambra Palace Granada, Spain The Nasrid Scholars

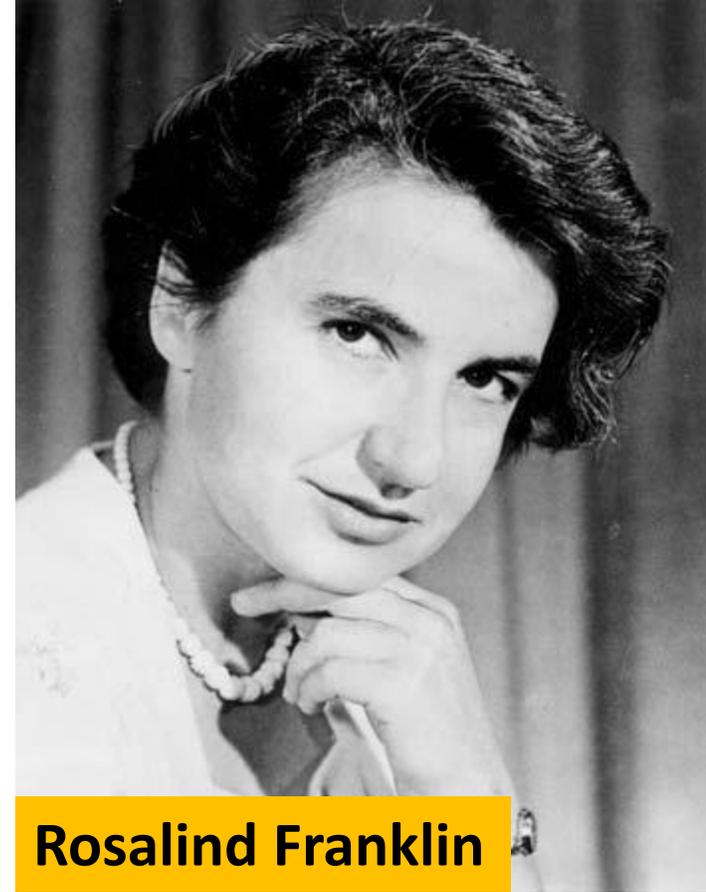
“A supply was established by building a dam and aqueduct from the River Darro over six kilometers away. This channel, the Acequia Real, was the first to bring water to the palace and the beginning of a complex water network for the growing palace-city. Subsequent improvements included reverse qanāts, an ingenious irrigation system that takes river, run-off and subterranean water and channels it underground towards the hill, where it pools in a cistern beneath the complex. Recent discoveries suggest that complex hydraulic devices were then used to draw water up to the palace.”

<https://omrania.com/inspiration/water-management-why-the-alhambra-palace-was-ahead-of-its-time/>



# WATER QUALITY

- Microbes – DNA
- Ethics – Copying other people’s work (Watson-Crick)
- Lack of self-confidence-Rosalind Franklin
- Rosalind Franklin-Structure of activated carbon used in drinking water
- Disinfection-Chicks Law



Rosalind Franklin

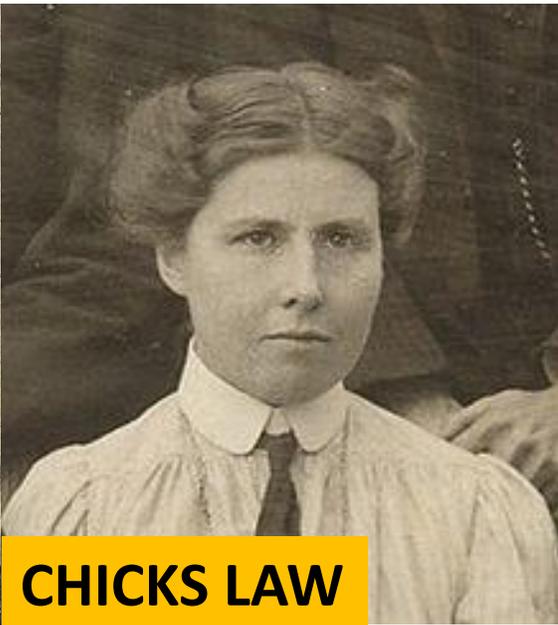
370-415  
**HYPATIA**  
OF ALEXANDRIA  
MATHEMATICIAN

FIRST WOMAN IN HISTORY TO MAKE CONTRIBUTIONS IN HER FIELDS.

WAS A COMPILER, EDITOR, AND PRESERVER OF EARLY MATHEMATICAL WORKS. SHE WAS THE FIRST WOMAN TO WRITE ON MATHS AND REFINE EQUATIONS.

WAS THE HEAD OF THE PLATONIST SCHOOL WHERE SHE TAUGHT MATH, PHILOSOPHY, AND SCIENTIFIC ASPECTS OF NEOPLATONISM.

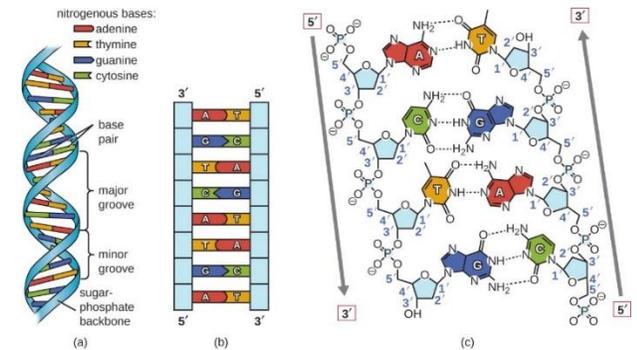
HER DEATH MARKED THE DECLINE OF ALEXANDRIA AS A CENTER OF LEARNING.



CHICKS LAW

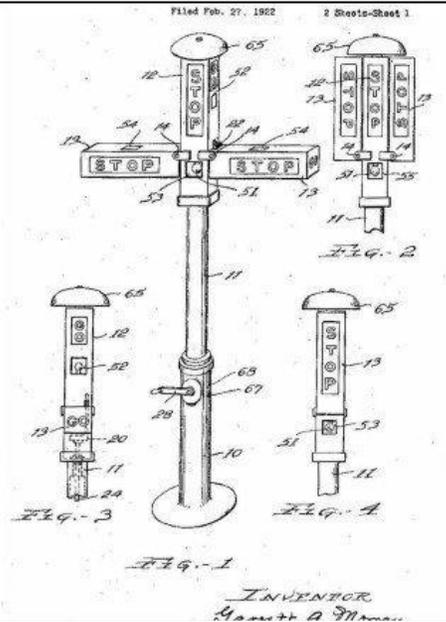
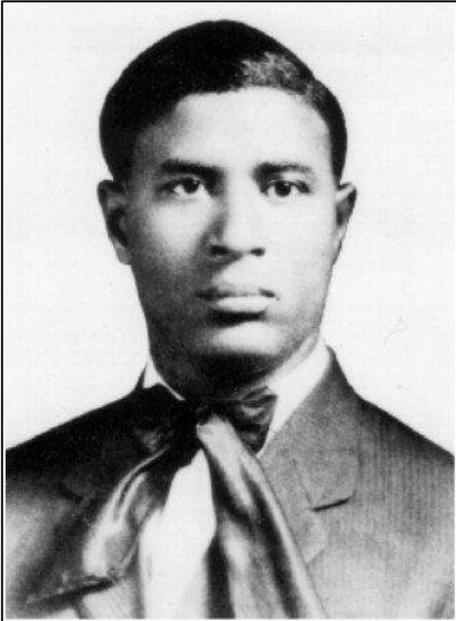


Henrietta Lacks



# TRANSPORTATION ENGINEERING

## The GREAT SILK ROAD



### Garrett Morgan Traffic Signal System

**CEE Materials:** This project asks students to explain at least three differences in the AASHTO standards of USA and any selected country from Asia, Central America, South America or Africa.



**Video presentations; Team projects;**

# TRANSPORTATION EQUITY

WHEN THE INFRASTRUCTURE IS ONLY COMFORTABLE FOR A SMALL GROUP OF PEOPLE...

THIS ISN'T SO BAD.

NOPE.  
NOT A CHANCE!

ONLY A FEW WILL USE IT.

WITH INFRASTRUCTURE THAT IS COMFORTABLE AND SAFE FOR MOST PEOPLE...

HMM,  
THIS ISN'T SO BAD,  
EITHER

AHH, MUCH BETTER...

FEWER PEOPLE ARE EXCLUDED FROM USING IT.

# TRANSPORTATION EQUITY

- Transportation planning and policy can affect both racial and social equity.
- Build healthy, equitable communities through **transportation** funding, policy, and projects.

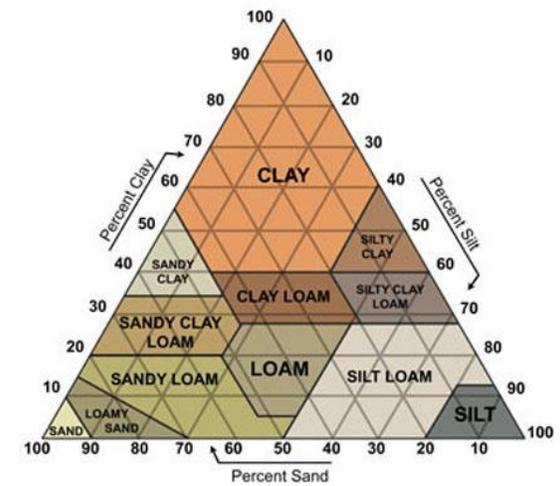
## Transportation Planning Equity Impacts:

- The quality of transportation available affects people's economic and social opportunities.
- Transport facilities, activities and services impose various indirect and external costs, such as congestion delay and accident risk imposed on other road users, infrastructure costs not funded through user fees, pollution, and undesirable land use impacts.
- Transport expenditures represent a major share of household, business and government expenditures.
- Transport facilities require significant public resources (tax funding and road rights of way), the allocation of which can favor some people over others.
- Transport planning decisions can affect development location and type, and therefore housing accessibility, land values and local economic activity.
- Transport planning decisions can affect employment and economic development which have distributional impacts.

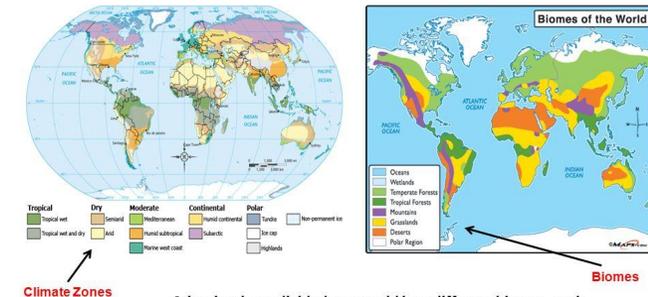


# GEOTECHNICAL ENGINEERING

- Mexico city clays amplify earthquake vibrations causing tremendous damage as seen during the recent September 19, 2017 earthquake. To complete this assignment, please research the type of soil deposits found in Mexico City
- From a humanitarian standpoint, what was the human loss of life during the recent earthquake? What is the estimated damage? Please provide references.
- What do research articles state about why the damage you see in Mexico City is more than you see in other parts of the world for a similar magnitude earthquake?
- What characteristics of these deposits cause the amplification of earthquake vibrations?
- Do the current building codes in Mexico City take into account these site conditions? If not, how can they?
- What are some of the construction strategies that future civil engineers can employ so that damage can be minimized and human life preserved?



Climate Zones, Vegetation Regions, Biomes, and Ecosystems



Scientists have divided our world into different biomes, such as grasslands, deserts, rainforests, deciduous forests, and marine environments. A biome is a large geographical region with plants and animals that are able to live in that location with its particular climate because they have adapted in different ways to the amounts of water, heat, and soil in that area.



FOOD & HUNGER  
**The Key to Ending World Hunger?  
Healthy Soil, UN Says**

It's a dirty job, but somebody has to do it.

# GEOTECHNICAL ENGINEERING

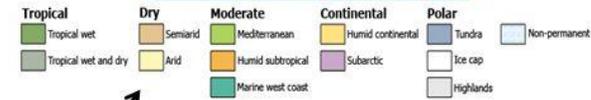
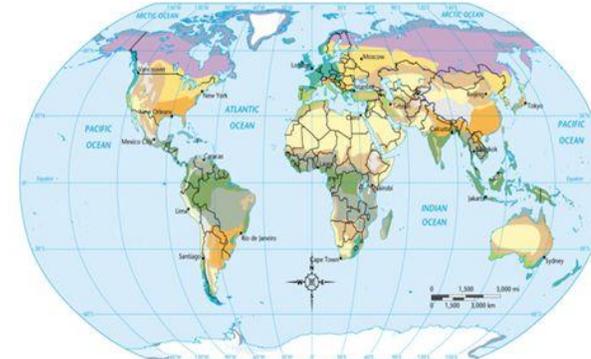
You can emphasize that soils are not only required for building foundations but they are intimately related to world hunger.

Soils are also a major player in the growth of civilizations and the arts through pottery.

## Mud Hut Design and Strength



## Climate Zones, Vegetation Regions, Biomes, and Ecosystems



Climate Zones

Biomes

Scientists have divided our world into different biomes, such as, grasslands, deserts, rainforests, deciduous forests, and marine environments. A biome is a large geographical region with plants and animals that are able to live in that location with its particular climate because they have adapted in different ways to the amounts of water, heat, and soil in that area.

Terzaghi, the father of geotechnical engineering struggled with a dark side.

## Professional Jealousy

Karl Terzaghi



The Engineer as Artist

Richard E. Goodman  
Foreword by Ralph Peck

ASCE PRESS



## HISTORY

- Pinch pots are some of the oldest ceramic artifacts found around the world.
- Before the invention of the Potter's Wheel and Kiln, pottery was strictly hand built and mostly valued for function.

# ELECTRICAL ENGINEERING



**Hertha Ayrton**

First female member of the IEEE, and her work on the electric arc and the Ayrton Flapper Fan used to clear the trenches of poisonous gas.



**Hedy Lamar**

developed a radio guidance system for Alliedtorpedoes that used spread spectrum and frequency hopping technology to defeat the threat of jamming. The principles of this work are incorporated into Bluetooth technology and are similar to methods used in legacy versions of CDMA and Wi-Fi.

## ADA LOVELACE

### FIRST COMPUTER PROGRAMMER

 **The Analytical Engine**

Lovelace's program turned a complex formula into simple calculations that could be encoded on punched cards and fed into Charles Babbage's Analytical Engine, a mechanical computer that he designed but never built. She published it in 1843, a century before the modern computer age.

*"I want to put in something about Bernoulli's Number, in one of my Notes, as an example of how an explicit function may be worked out by the engine, without having been worked out by human head and hands first."*

$$\frac{x}{e^x - 1} = \frac{1}{1 + \frac{x}{2} + \frac{x^2}{2 \cdot 3} + \frac{x^3}{2 \cdot 3 \cdot 4} + \&c.}$$

 **A Universal Computer**

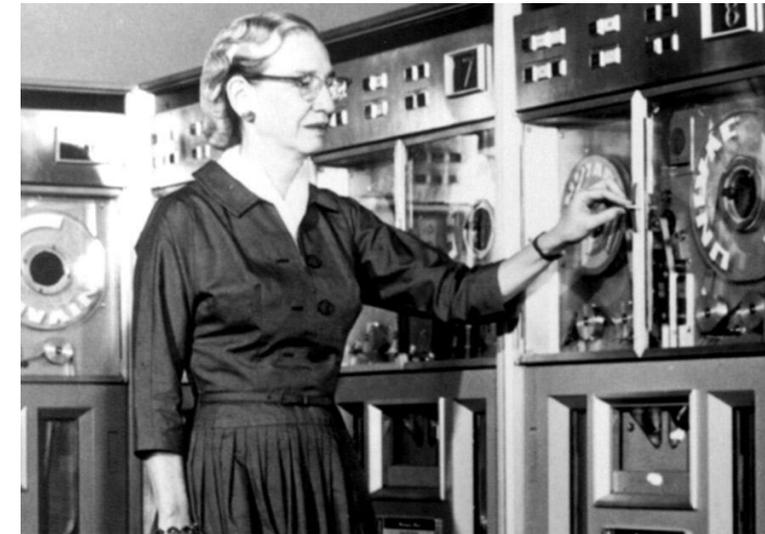
Lovelace did more than write the first computer program. She was also the first person to realise that a general purpose computer could do anything, given the right data and instructions.

*"The Analytical Engine weaves algebraic patterns just as the Jacquard loom weaves flowers and leaves."*

*"Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent."*

 **Augusta Ada King, Countess of Lovelace**  
**Born: 10 December 1815**  
**Died: 27 November 1852**

  
Ada Lovelace Day  
FindingAda.com



**Grace Hopper**

Hopper was a pioneer in computer science, who helped to invent the compiler and COBOL (and even the word 'bug') at a time when few women had access to the male-dominated world of math and physics.

**YALE-GRACE HOPPER COLLEGE**

# COMPUTER PROGRAMMING

Advertisements depicting women not knowing how to use technology became ubiquitous, stereotypes of the male nerd or hacker emerged, gaming aimed at men also started gaining prominence, and these were reinforced by the growth of popular computing companies run by 'male geniuses'

" My methods [of algebra] are really methods of working and thinking; this is why they have crept in everywhere anonymously. "



Emmy Noether



*Alan Turing*  
FATHER OF MODERN COMPUTING  
CASUALTY OF BIGOTRY & IGNORANCE

In addition to basically saving the world during World War II by helping crack the 'impenetrable' Enigma code used by the Nazis, Alan Turing's elaborate thought experiments became the precursor on which modern computers were built.

Despite his invaluable contributions to science, Turing was also a homosexual male, which was still a crime in the UK in the 1950's. Given the choice between chemical castration and imprisonment, he chose the former.

He killed himself 2 years later.

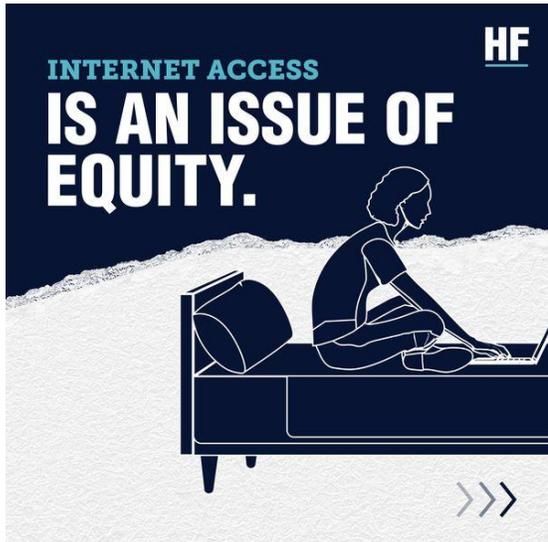
*It is harder to crack a prejudice than an atom.*



" ...Fearing the ridicule attached to a female scientist, I have previously taken the name of M. LeBlanc in communicating to you those notes that, no doubt, do not deserve the indulgence with which you have responded. "

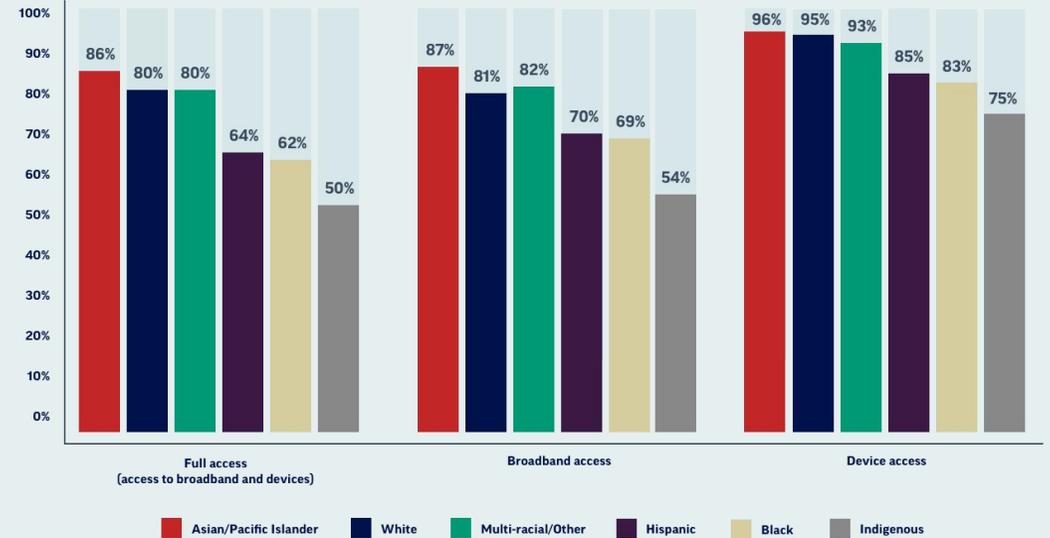
Sophie Germain





# DIGITAL EQUITY

## Students of color do not have the same access to devices or to broadband



**EVOLVING SCALE OF DIGITAL EQUITY**

In many ways, the connectivity and access to the internet has transformed education at all levels. The ability for students to access learning materials online as well as for instructors to share lessons and collaborate has revolutionized teaching and learning. Where education used to be concentrated in school buildings, it can now be accessed by millions of people (almost) anywhere.

**Stage 1: Wired Only**

- Classroom or lab-centric
- Slow downloads with mass users
- Typically inhibited media access to email files/PDFs
- Limited based on # of users
- Some network crashes
- "Big pipe" focus (T-1 lines, etc.)
- Wired or dial-up

**Stage 2: Wireless Access Points**

- All Access / "First-In" faster
- Teacher-centric classrooms only
- Limits on surfing and streaming (Filter blocks on YouTube/videos)
- Interactive E-books
- Links with flat content
- Simple downloads
- Google Docs/Office 365
- Wi-Fi at 2.4 GHz on 802.11g
- Unreliable/lots of network crashes

**Stage 3: Institution-wide Wireless/Remote**

- Teacher-centric & common areas
- Some streaming
- More Courseware & denser files
- Supplemental learning objects used
- Remote access
- Videos/everyone streaming
- Multi-devices
- Digital Collections, Skype, any gaming learning
- WiFi 2.4 GHz on 802.11b/g/n
- More access points

**Stage 4: Social/Community Wide**

- Access supports beyond institution to social community. Greater density comes into play
- Parental and industry access
- Infrequent multi-modal and remote users
- Uninterrupted video streaming and conferencing
- Remote collaborators in other schools and nations
- Wi-Fi at 5 GHz on 802.11n/ac Wave 1

**Stage 5: High Density Net Ecosystem**

- Web 3.0, Internet of Things. Access supports virtual teaching—special subjects and many devices/objects
- Always-on high frequency multi-modal video streaming
- Dense courseware and animation graphics creation
- "Binge-On" Invisible Net Ecosystem
- Extra-Limital Learning
- Sophisticated internal and visitor access
- Ultra connectivity—multi-device/objects
- Wi-Fi at 5 GHz on 802.11ac Wave 2

**5 Billion** Households with school-aged children do not have access to the internet.

**75%** Of school systems surveyed do not have any off-campus strategies for providing connectivity to students at home and after school.

**80%** Of schools cite institution-wide network but it is inadequate for burgeoning use of digital curriculum.

**"Unreliable"** Opinion of most instructors surveyed about their Networks.

Source: Learning Counsel Digital Curriculum Strategy Survey and Assessment Tool 2016, Pew Research Center, 2014

# ETHICS

- AUTOMOBILE INDUSTRY



## MKs HAWAII LAND ACQUISITION



# Integration of Humanities

## Semester Project

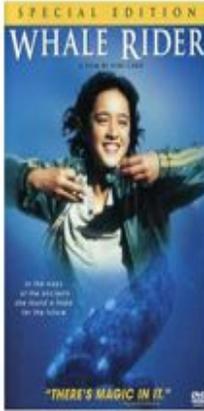
- Divide teams and assign a state (USA) or a country
- Teams research government, religion, society, culture, resources and the status of science & technology
- Identify Grand Engineering Challenges for their country
- Teams research how algae can help “Grow the Future” of their assigned country. They identify challenges - both scientific and social that can deter use of algae.



## Movies/Documentaries

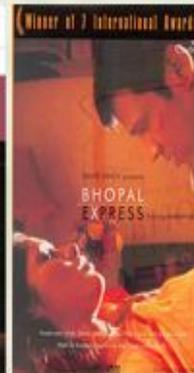
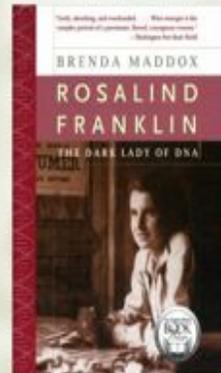
*Introduce students to ethics, gender biases, social and environmental injustices*

- Erin Brockovich
- Civil Action
- Whale Rider
- Bhopal Express
- Rabbit Proof Fence
- Hidden Figures



## Philanthropy

- Billions in Change
- Gift of Light
- Water for People

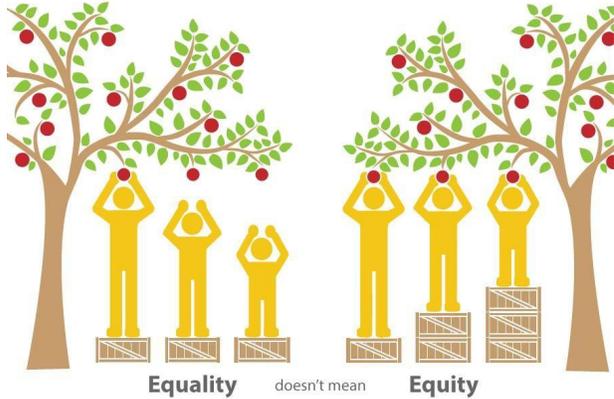


## Communication Skills

Written-Memos,  
Technical reports  
Oral-Presentations  
Reflective Essays



# CEE RevED CURRICULUM SURVEY



## CEE RevED CURRICULUM SURVEY

**Question 1: Do you think the course adequately covered the following topics?**  
(1=Not Covered                      5= Adequately Covered)

- a) Global Issues
- b) Societal Issues
- c) Ethical Issues
- d) Problem Solving Techniques
- e) Engineering Design
- f) Diversity & Inclusivity

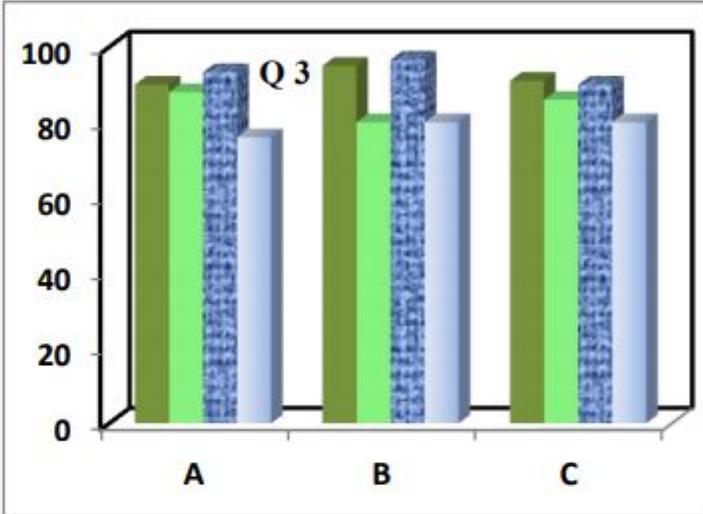
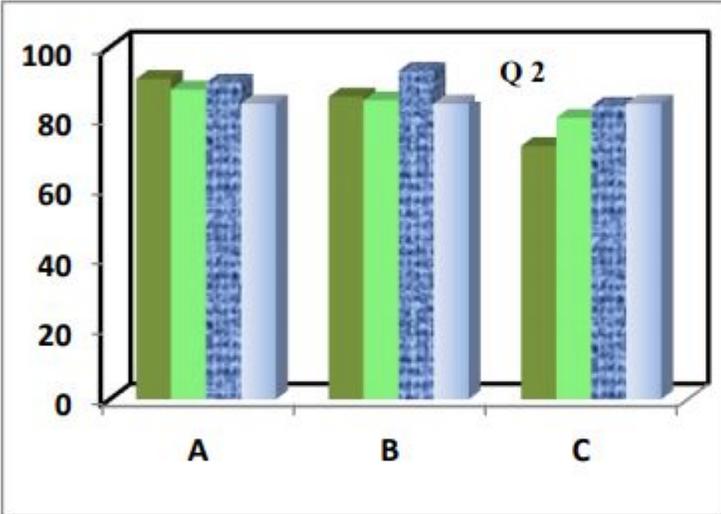
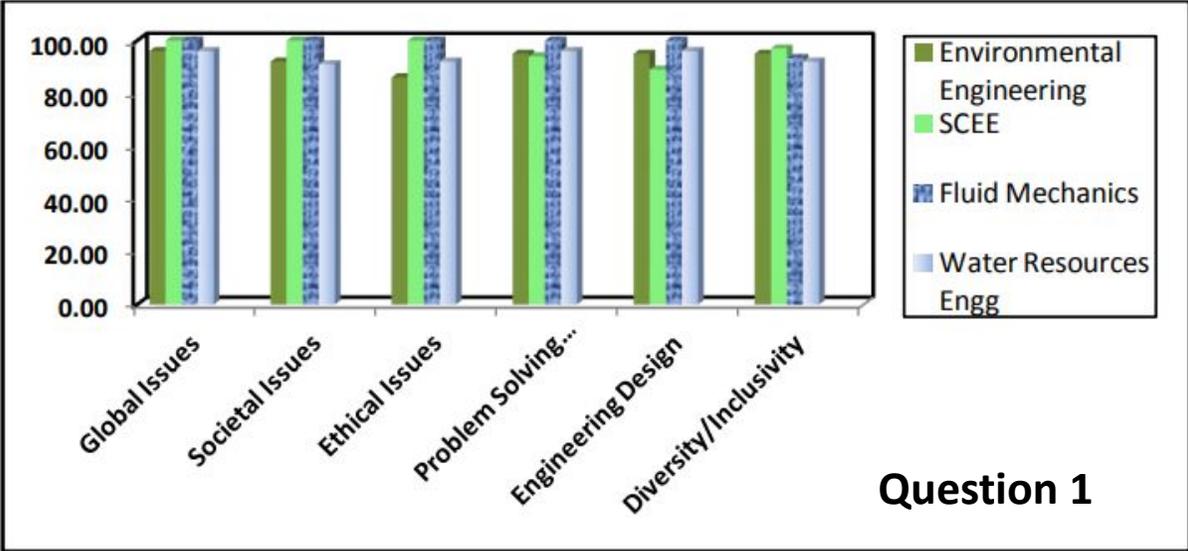
**Question 2: The course**  
(1= Strongly Agree      5= Strongly Disagree)

- A) Included socially relevant examples of engineering work
- B) Increased my interdisciplinary knowledge
- C) Exposed me to the arts, social sciences and humanities as relevant

**Question 3: The course**  
(1= Strongly Agree      5= Strongly Disagree)

- a) Used various types of graded work
- b) Used open-ended problems
- c) Provided opportunities for collaborative work

# RESULTS FROM COURSE SURVEY



# CEE GOES GREEN 2005-Till Present

3 R (Reduce Reuse Recycle)

Green Engineering

Climate Change

Carbon Footprint

Greenhouse Gases

Zero Discharge

Alternate Energy

LCA (Life Cycle Analysis)

DFE (Design for the Environment)

LEED

Public Policy

Bruntland Report

Grand Challenges

United Nations Millennium Development Goals

Kyoto Protocol



Engineers without Borders

ASCE

REAL - Rowan Environmental Action League

Engineers on Wheels

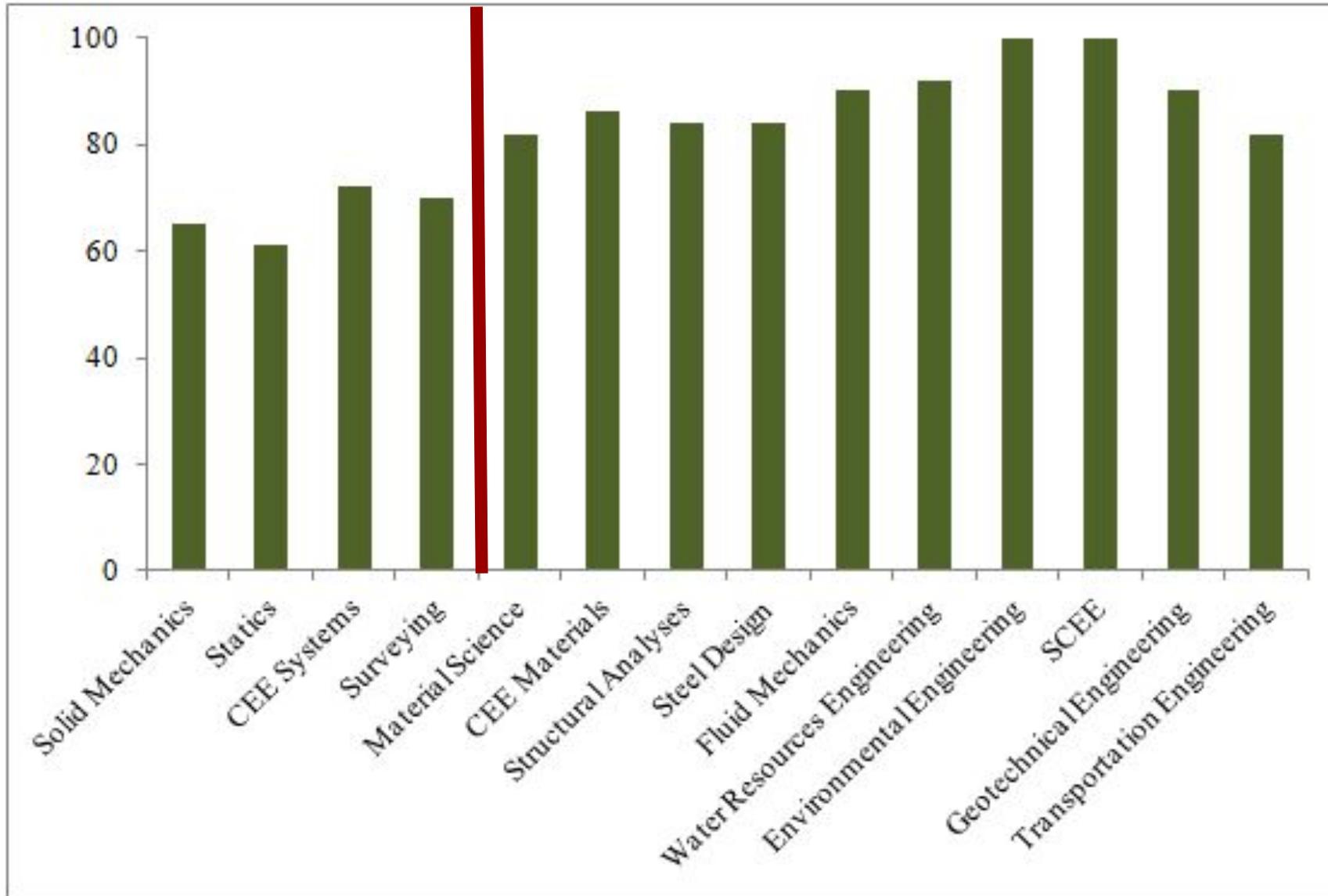
Sustainability Facilities Center

Center for Research and Education in Transportation Engineering Systems

Entrepreneurial Mindset (Kern

Entrepreneurial Engineering Network-KEEN)

# SUSTAINABILITY SURVEY



**3 Rs**  
**Green Engineering**  
**Carbon Footprint**  
**Climate Change**  
**LEED**  
**Alternate Energy**

**LCA**  
**DFE**

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**@rowancivil**

**@doctorjahan**



# Acknowledgements



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Rethinking Engineering Diversity,  
Transforming Engineering Diversity  
(REDTED)**

