Practices for Developing Inclusive Curriculum and Climate for the Civil Engineering Department

Department of Civil and Environmental Engineering

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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 2020
$15 Million
MULTI-PRONG APPROACH TO DEI (Diversity, Equity and Inclusivity)

Eliminates many students from many groups

- Revise admissions criteria
- Provide D&I training to faculty and administrators
- Expose role models from Industry/academia
- Integrate D&I concepts in core courses
- Mentoring programs for at risk groups
- GPA
- AP Courses
FACULTY DEVELOPMENT

DEPARTMENT

- Faculty Training in D&I via an all day workshop
- Faculty Development of Course Materials
- Assistance provided for Course Material Development
- Implementing new course content in existing core courses
- Spring 2019 and Fall 2019
- Assess the impact of the new course content

UNIVERSITY

DEI OFFICE

FACULTY DEI CERTIFICATE

FACULTY CENTER INCLUSIVE PEDAGOGY CERTIFICATE

PIPER GRANTS
Rowan Student Baseline Demographics
(SJICR Fall 2016)
## Different Experiences and Perceptions (Fall 2018)

<table>
<thead>
<tr>
<th></th>
<th>1st Gen</th>
<th>Sexual minority</th>
<th>Women</th>
<th>Diff. Abled</th>
<th>Non-White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation in Engr-related activities</td>
<td>Less</td>
<td>More</td>
<td>--</td>
<td>Less</td>
<td>Less</td>
</tr>
<tr>
<td>Inclusive Classroom Experiences</td>
<td>--</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
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<tr>
<td>Educational Experiences</td>
<td>Less</td>
<td>Less</td>
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<td>Less</td>
<td>Less</td>
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<tr>
<td>Experiences with discrimination</td>
<td>More</td>
<td>More</td>
<td>More</td>
<td>More</td>
<td>More</td>
</tr>
<tr>
<td>Diversity Climate</td>
<td>--</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
<td>Less</td>
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CHANGE DEPARTMENT CLIMATE/CULTURE

- Faculty workshops on Diversity Equity Inclusivity (Checklist)
- 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, brochures 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
MORE: Mentoring Opportunities Reinforcing Excellence
First Year student paired with a Junior/Senior ASCE Student Chapter
MEETS:
Mentor
Energize
Engage
Transfer
Students

Monthly Meetings
Social Networking
Academic Progress
Registration
Jobs/Resume Writing
BRIDGE - Building a Resilient Inclusive, & Diverse Graduate Environment
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.
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.
## STRATEGIES FOR COURSES

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

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 grams/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, 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.

ACCOMMODATION

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!
TEAM NAMES

• Assign teams a name of a person of influence or the team adopts a country. Use examples that are global and a learning opportunity for the students. *Not every person assigned has to be a scientist or engineer.* Have the team use the name throughout the semester. Present for 2 minutes about the assigned person every other week.

• Example- Henrietta Lacks, Ruth Bader Ginsburg, Nelson Mandela, Queen Victoria (major scientific contributions made during her reign), Vandana Shiva, Arundhati Roy, F. R. Khan etc
MOVIES AND DOCUMENTARIES

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
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
REWORDED 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 sheer force ... > Bamboo was used for xx member. This was to address sustainable green engineering. Determine the sheer force

• Calculate the alum dose .... > Alum is an universal coagulant and is used extensively in poor and 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

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

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

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

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
Kevlar has many applications, ranging from bicycle tires and racing sails to body armor, because of its high tensile strength-to-weight ratio; by this measure it is 5 times stronger than steel.
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
HOW DO THE FOUNTAINS WORK IN THE TAJ MAHAL?

For the fountains in the north-south canal and the lotus pond and its canal, copper pipes were used. To ensure uniform and undiminished water pressure in the fountains, a copper pot was provided under each fountain pipe. The water supply came first into the pot only and from there, rose simultaneously in the fountains, which means that the fountains were controlled by the pressure in the pots rather than pressure in the pipes. The main supply of the water in these pots came through earthenware pipes, some of which were replaced with cast iron back in 1903.
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.”

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.
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.
• 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?
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

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

Professional Jealousy

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.
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.

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
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’.

“...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

- Full access (access to broadband and devices)
- Broadband access
- Device access

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<thead>
<tr>
<th></th>
<th>Asian/Pacific Islander</th>
<th>White</th>
<th>Multi racial/Other</th>
<th>Hispanic</th>
<th>Black</th>
<th>Indigenous</th>
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</thead>
<tbody>
<tr>
<td>Full access</td>
<td>86%</td>
<td>82%</td>
<td>80%</td>
<td>64%</td>
<td>62%</td>
<td>50%</td>
</tr>
<tr>
<td>Broadband access</td>
<td>87%</td>
<td>81%</td>
<td>82%</td>
<td>70%</td>
<td>69%</td>
<td>54%</td>
</tr>
<tr>
<td>Device access</td>
<td>96%</td>
<td>95%</td>
<td>93%</td>
<td>85%</td>
<td>83%</td>
<td>75%</td>
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- 80% of school-aged children do not have access to the internet.
- Of school-aged children surveyed, 80% did not have reliable internet access.
- In many ways, the convenience and accessibility that the internet has provided education at all levels. The ability for students to access learning materials online as well as to download and view resources for instruction can now be more accessible to millions of people wherever they are.
Q7 - How was the climate of diversity in the department/college/university (in classrooms, outside of classrooms)?

- There was a shocking lack of people of color.
- As a gay Male, I felt the climate for diversity was great and inclusive.
- Stop pushing so hard for student and faculty diversity. I'd rather see a push for more class sections, better resources, etc.

Q6 - Were you treated fairly and with respect by the non-engineering students at Rowan? 1 = Poor  5 = Excellent
# 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
Make engineering come alive by adding/integrating engineering feats with the human experience of gender biases, discrimination, marginalization, suffering, ethical violations and shortcomings of leaders that may appear to be perfect in their theories and contributions.
Acknowledgements

NSF (IUSE 1610164)
Algae Grows the Future

NSF (IUSE/PFE:RED- 1623053)
Rethinking Engineering Diversity,
Transforming Engineering Diversity
(REDTED)