

A photograph of a pregnant woman lying on a table, looking up at a monitor displaying an ultrasound scan. The image is framed by decorative white and blue circular shapes. The background features a light blue pattern of interconnected circles and lines.

Diversity and Culture of Inclusion/ Engineering and Workforce Development

Valerie Purdie Greenaway, Columbia University
Tim Downing, University of California, Irvine
Naomi Chesler, University of California, Irvine
Michelle Oyen, Washington University in St. Louis



“ I was always interested in physics and chemistry in high school. If we studied phenomena like pregnancy and the biomaterial that holds a baby in science classes, I would probably be an engineering major today instead of pre-med.”

Chiamaka Okonkwo, Research Assistant for EWD/DCI
classroom intervention project.
December 2, 2021

DCI & EWD Team



Valerie Purdie-Greenaway, CU
Diversity & Culture of Inclusion Lead,
Education Workforce Development Co-Lead



Naomi Chesler, UCI
Diversity & Culture of Inclusion
Co-Lead, Healthy Aging Testbed
Co-Lead



X. Edward Guo, CU
Lead PI, Center Director,
Healthy Aging Lead



Kristin Myers, CU
Deputy Director, Preterm Birth Co-
Lead



Timothy Downing, UCI
Engineering Workforce
Development Lead, Diversity &
Culture of Inclusion Co-Lead



Michelle Oyen, WUSTL
Co-PI, Experimental Cellular & Tissue
Mechanics Co-Lead, Engineering
Workforce Development Co-Lead,
Preterm Birth Co-Lead



Lance Kam, CU
Deputy Director, Mechanomics Lead



Steven Abramowitch, Pitt
Co-PI, Pelvic Floor Disorders Lead,
Multiscale Biomech. Computation &
Imaging Co-Lead, Multiscale
Modeling Theory Co-Lead

DCI/EWD Outline

- I. **DCI/EWD: Overarching Goals and Conceptual Framework**
- I. **EWD: Preparing Future Generations of Engineers**
- I. **DCI: Fostering and Sustaining an Inclusive Organizational Climate**



Grand challenges

How do we develop a diverse, equitable and inclusive institutional center suited to train the next generation of women's health care scholars and executives?



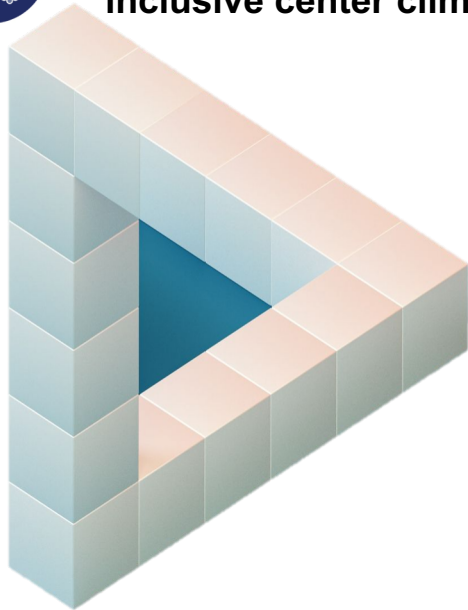
How do we broaden the participation of members of underrepresented groups in the engineering workforce and transform our imagination about the types of problems engineers solve?



What does inclusive excellence look like for IMWEL?



Diverse, equitable and inclusive center climate



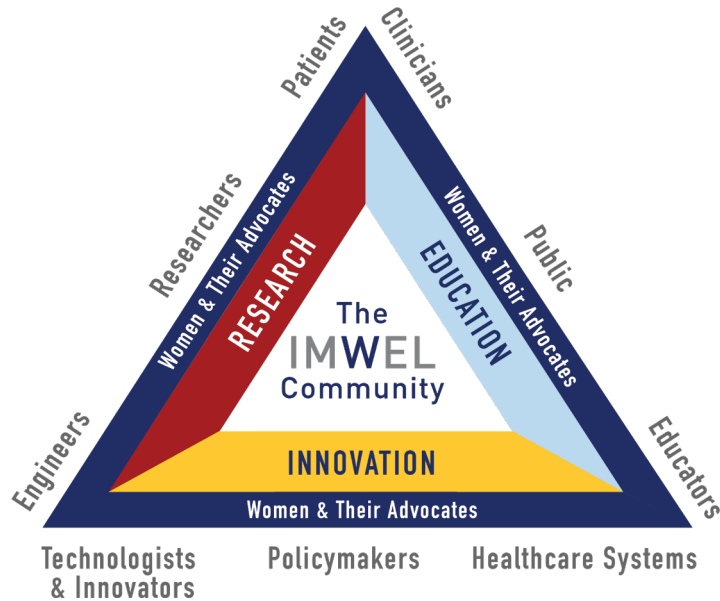
Multi-dimensional understanding of engineering challenges



Next generation of engineers



What does inclusive excellence look like for IMWEL?



Diverse and inclusive center climate

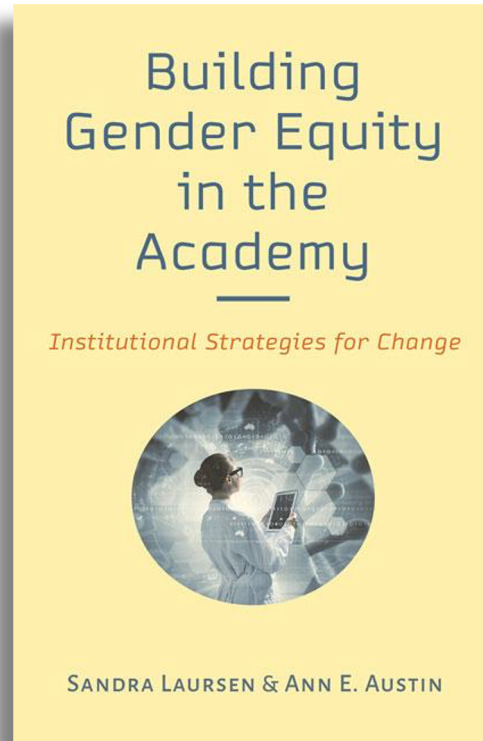


Multi-dimensional understanding of engineering challenges






Next generation of engineers

Evidence-based conceptual framework



Laursen, S., & Austin, A. E. (2020). *Building gender equity in the academy: Institutional strategies for change*. Baltimore, MD: Johns Hopkins University Press.

Evidence-based strategies

VISION	 Diverse and inclusive center climate		 Next generation of engineers			 Multi-dimensional understanding of engineering challenges		
STRATEGY	Inclusive climate within & across labs & research thrusts	Community & student board engagement	Inclusive hiring & retention	Educational intervention	Cultivate & support pathway programs	Visibility of historic & current challenges related to gender & intersectionality	Seed grants	Create accountability structures



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- I. DCI: Fostering and Sustaining an Inclusive Organizational Climates



Engineering Workforce Development



Our Team Spans Disciplines & Schools



Timothy Downing, UCI

Biomedical Engineering, Tissue Engineering, Regenerative Biology, Mechanobiology



Steven Abramowitch, Pitt

Bioengineering, Computational Modeling of Pelvic Floor, Soft Tissue Characterization, Vaginal Mesh Design



X. Edward Guo, CU

Biomedical Engineering, Mechanics of Soft Tissues, Preterm Birth, Hydrated Biomaterials



Tamer Ibrahim, Pitt

Bioengineering, Radiology, and Psychiatry, MRI Imaging



Aaron Kyle, Duke

Biomedical Engineering, Engineering Education, STEM Outreach, Medical Device Design Biomedical Instrumentation and Signal Processing



Michelle Oyen, WUSTL

Biomedical Engineering, Material Science, Mechanobiology of Implantation, Fetal Membrane Mechanics



Spandan Maiti, Pitt

Biomedical Engineering, Mechanical Engineering & Materials Science, Computational Mechanics



Pamela Moalli, Pitt

OB/GYN, Bioengineering, Uryo/Gyn, Vaginal Mesh Expert, Female Pelvic Floor Health



Valerie Purdie-Greenaway, CU

Social Psychology, Organizational Behavior, Interventions to Reduce Stereotype Threat, Diversity Science

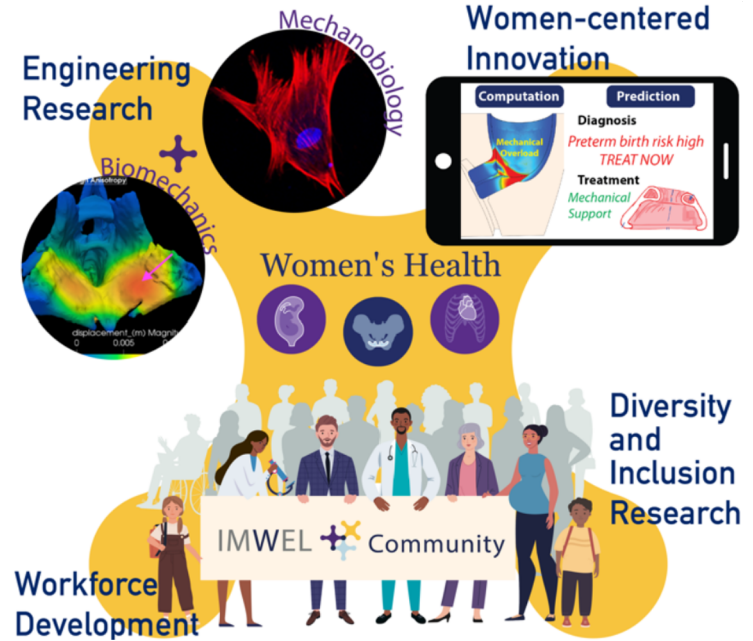


Ronald Wapner, CU

OB/GYN, Fetal Genetic Testing

Grand Challenges

1. Trainees and faculty hired today will shape the institution and the field in the years to come.
2. Transforming the way young people think about the kinds of problems engineers solve.
3. Individuals need to gain specialization and mentorship within subfields of engineering.



Develop future generation of engineers and innovators in Women's Health

We will:

Design, Test and Disseminate Education/Training Interventions

Develop, test, refine, and disseminate educational curriculum appropriate for a range of ages that holds relevance for engineering.

Establish and Support Pathway Programs

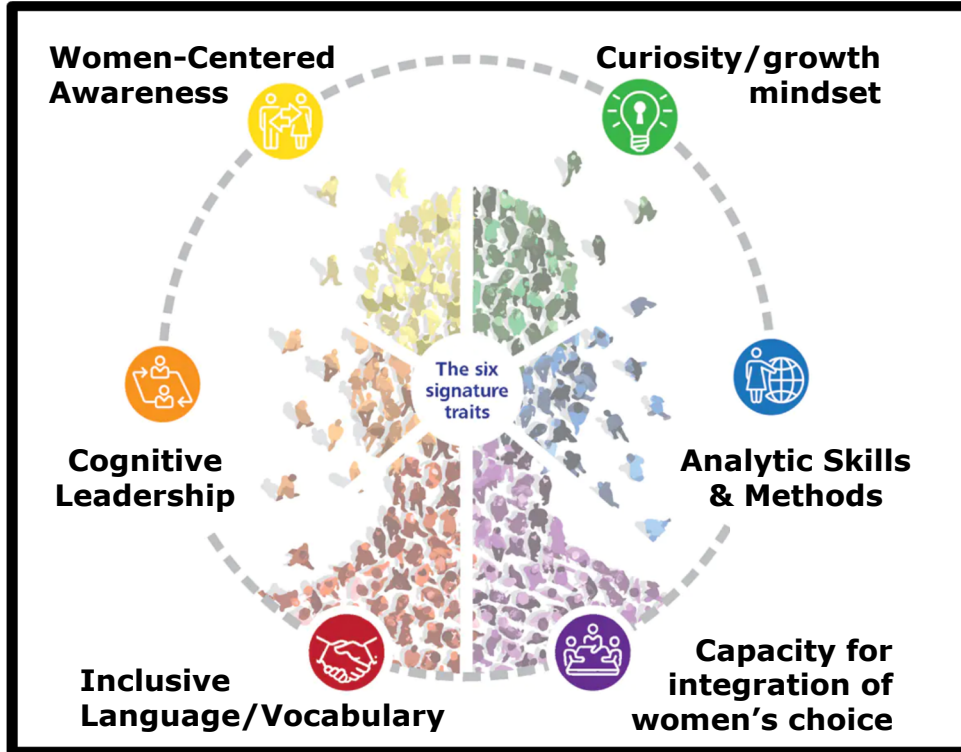
Offer high school, undergraduate, graduate, and postgraduate training opportunities and pedagogical tools to teachers and faculty.

Cultivate Inclusive Leadership and Mentorship

Introduce NSF Advance-inspired tools for search committees, hiring managers, and labs to reduce implicit bias and promote equity, diversity, and inclusive climates.



Workforce Inclusion Module for Engaging the Next Generation (WIMEN)



All training of EWD will center on six signature competencies related to inclusive excellence and women centered engineering.

What are the primary activities of EWD?



Post-doc/early career

IMWEL Postdoctoral Experiences and Research Activities

NSF Advance Faculty Development Program

The Center for the Improvement of Mentored Experiences in Research (CIMER)



Graduate

Graduate Research within IMWEL Ecosystem

Entrepreneurship in Women's Health

Rising Stars in Engineering in Women's Health

5th grade/middle school

STEM and Women's Health Intervention through Pregnancy-center module



High School

NSF Research Experience of Teachers (RET)

Textbook Development



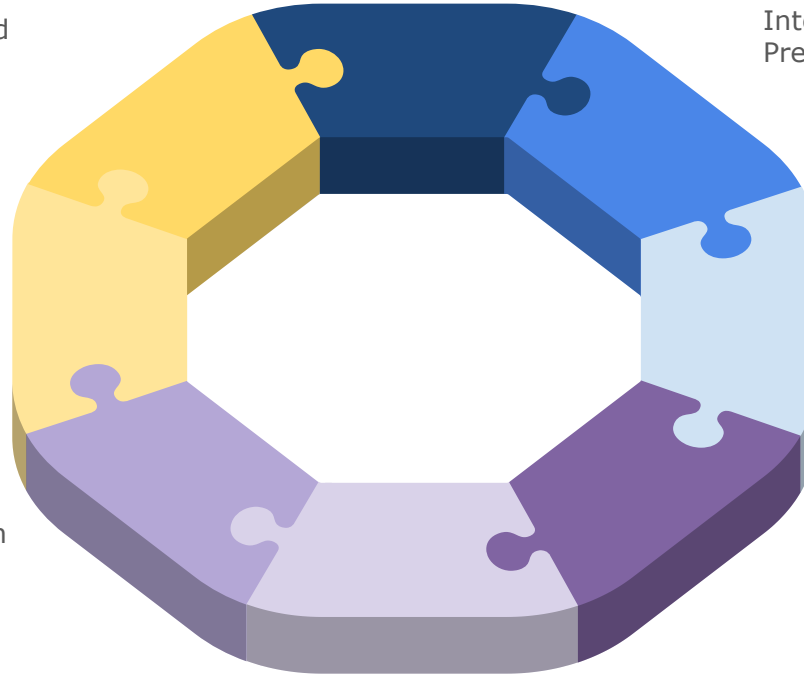
Undergraduate

Curriculum interventions in freshman- and senior-level engineering courses

Senior Design Projects in Women's Health

Integration of Women's Choice in Technology Development

IMWEL Research Experience for Undergraduates (REU)



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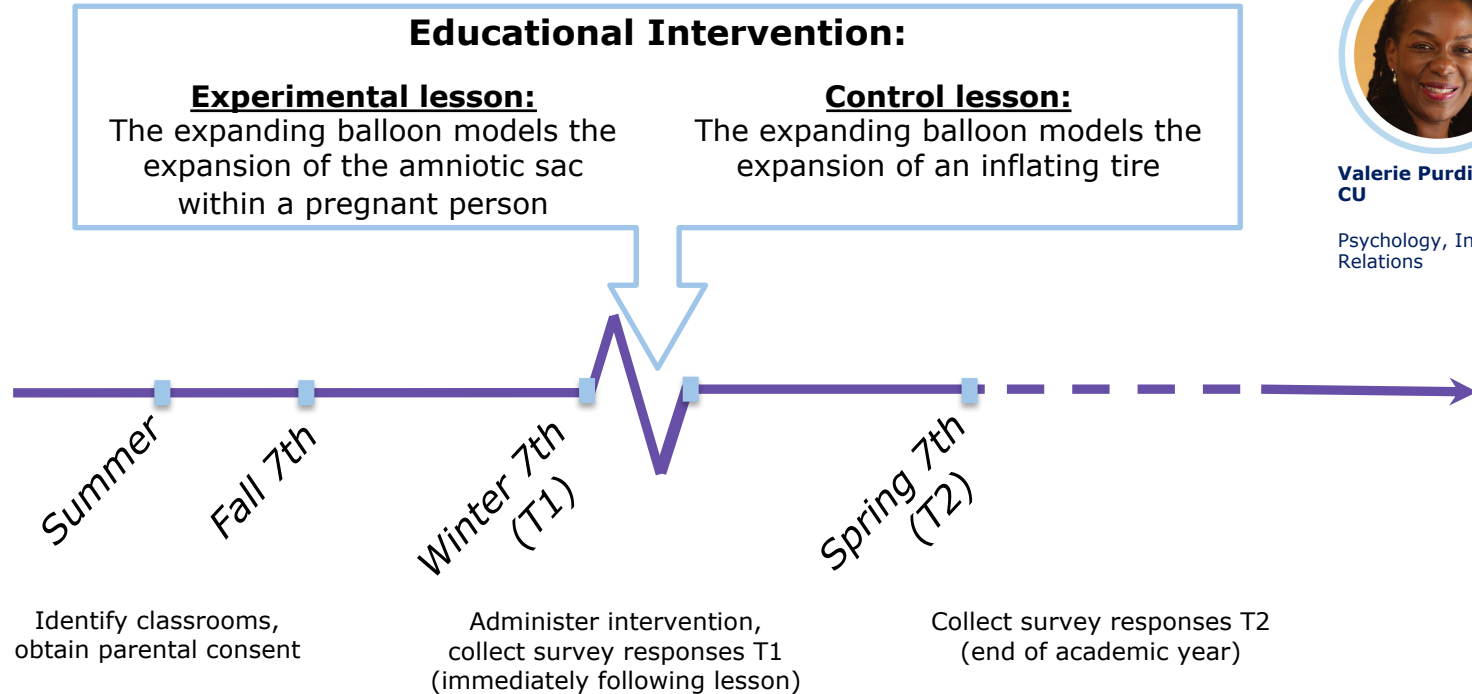
Educational Intervention: intellectual merit

Lack of theoretical frameworks to understand how to increase interest, motivation and career pathways related to mechanobiology and women's health.

- Our goal is to develop an empirically grounded framework. This framework will be usable by educators and scientists to enable scaling.
- The research methodology we will deploy is longitudinal randomized field experiments in middle school science classrooms and engineering college classrooms.



Educational intervention in middle schools (7th grade science): Randomized Control Trial Design



Valerie Purdie-Greenaway, CU

Psychology, Intergroup Relations

Educational intervention in middle schools (7th grade science): Randomized Control Trial Design



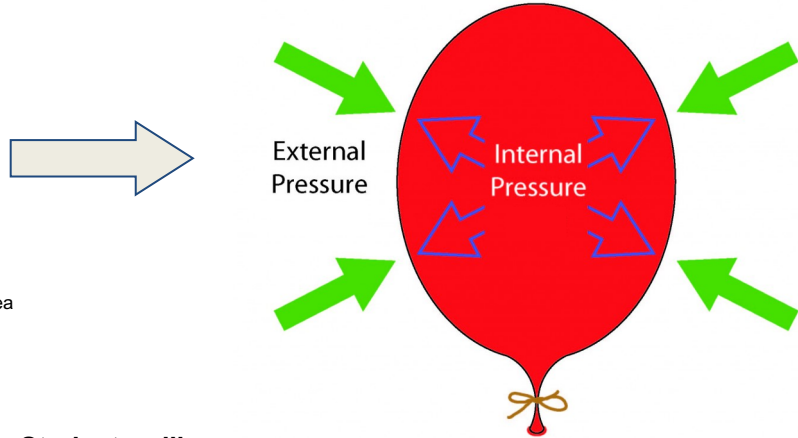
Teacher & Students



Benjamin Raikes
High School Teacher - New York Area



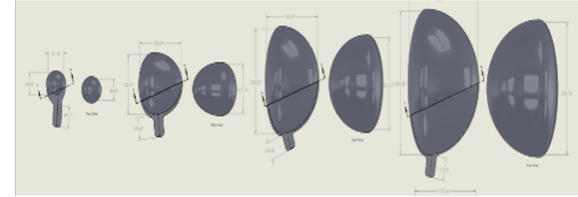
Lesson Set-Up



Students will:

- Investigate ways in which different 'stresses' (acidity, heat) can change a balloon's capacity to hold water.
- Observe how pressure changes with volume.
- Understand which factors need to be attended to make a fair test of the balloons.

Purpose of Lesson:



The expanding balloon models the expansion of the amniotic sac within a pregnant person.

Over the course of pregnancy, the uterus grows and stretches over 300% and then almost instantaneously contracts down to protect the mother!

Educational intervention in middle schools (7th grade science): Randomized Control Trial Design



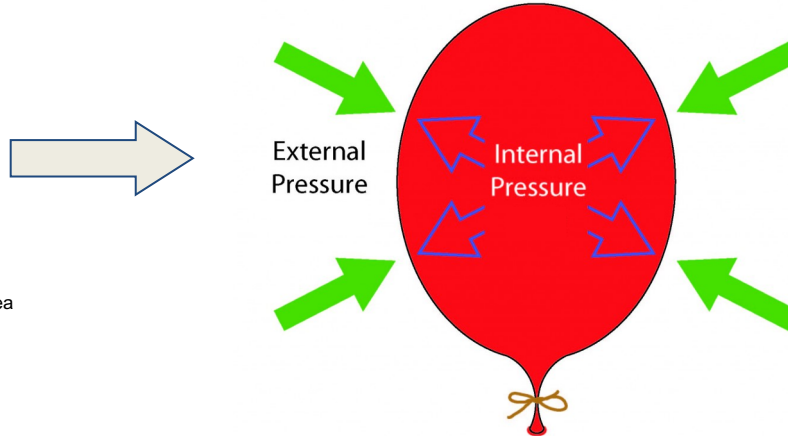
Teacher & Students



Benjamin Raikes
High School Teacher - New York Area



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Purpose of Lesson:



The expanding balloon models the expansion of an inflating race car tire

Modifications for high school and college courses: Pregnancy and the uterus



Middle School

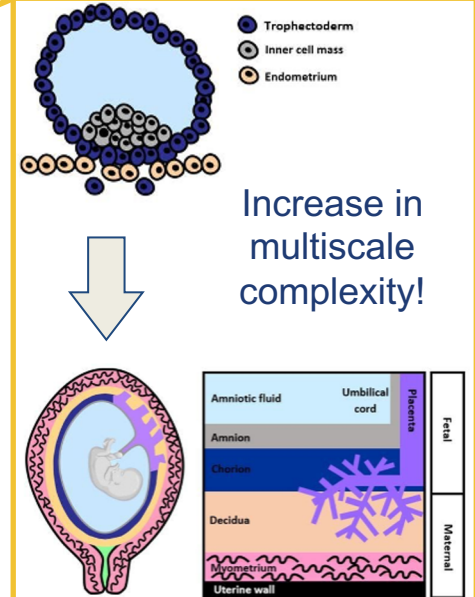
- Experiment with established set-up
- Discuss women's reproductive health at a developmentally appropriate level

High School

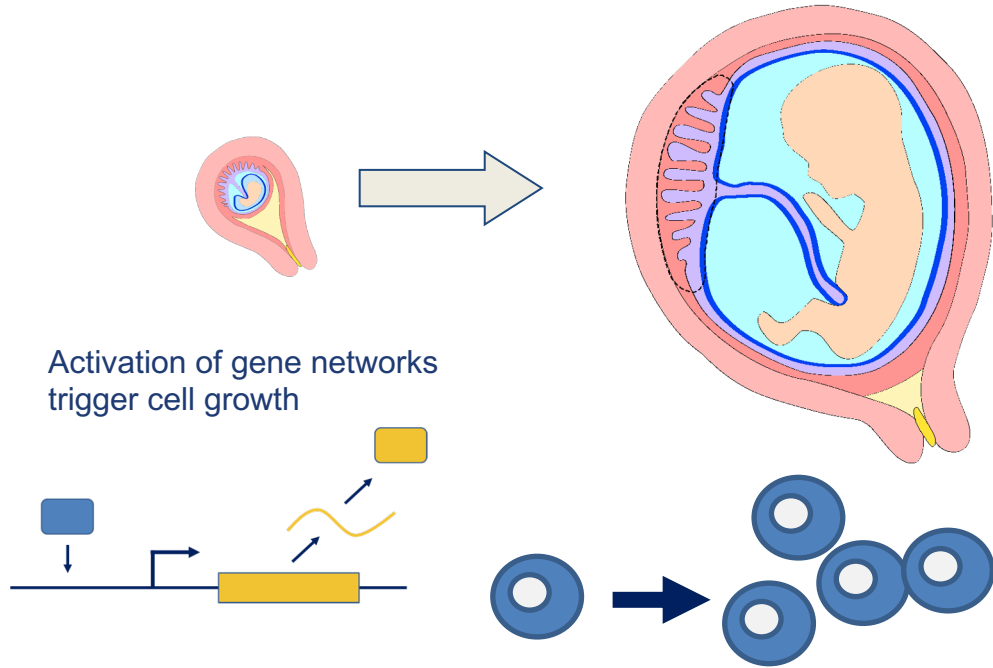
- Introduce the history of sexism and racism in science
- Introduce more anatomical terminology

College Students

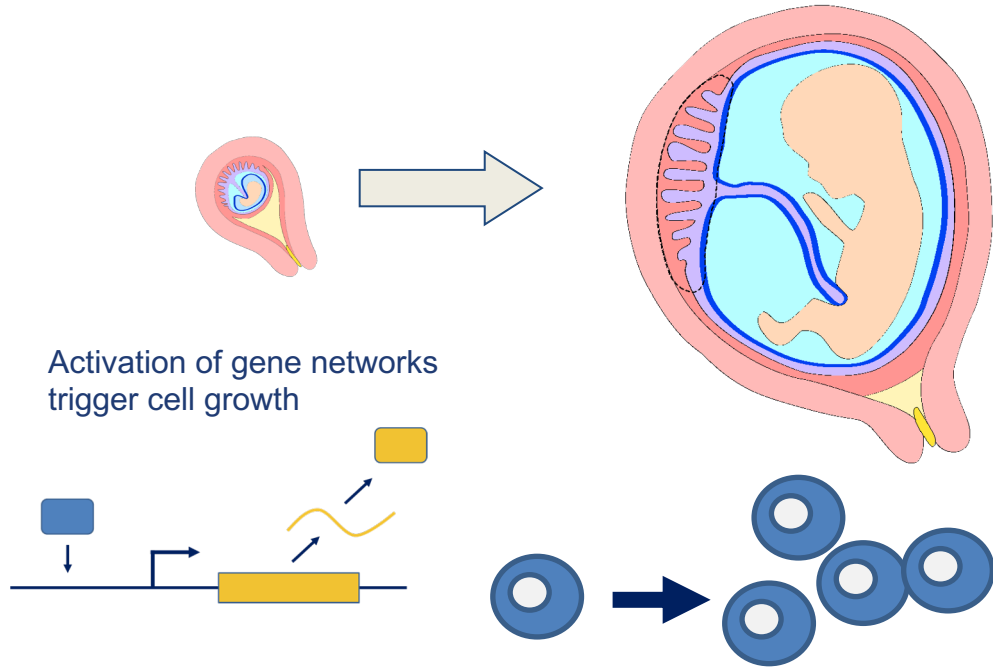
- Design and Model their own experimental materials
- Create new lessons at the intersection of mechanobiology and women's health



How do cells solve the tissue expansion problem?

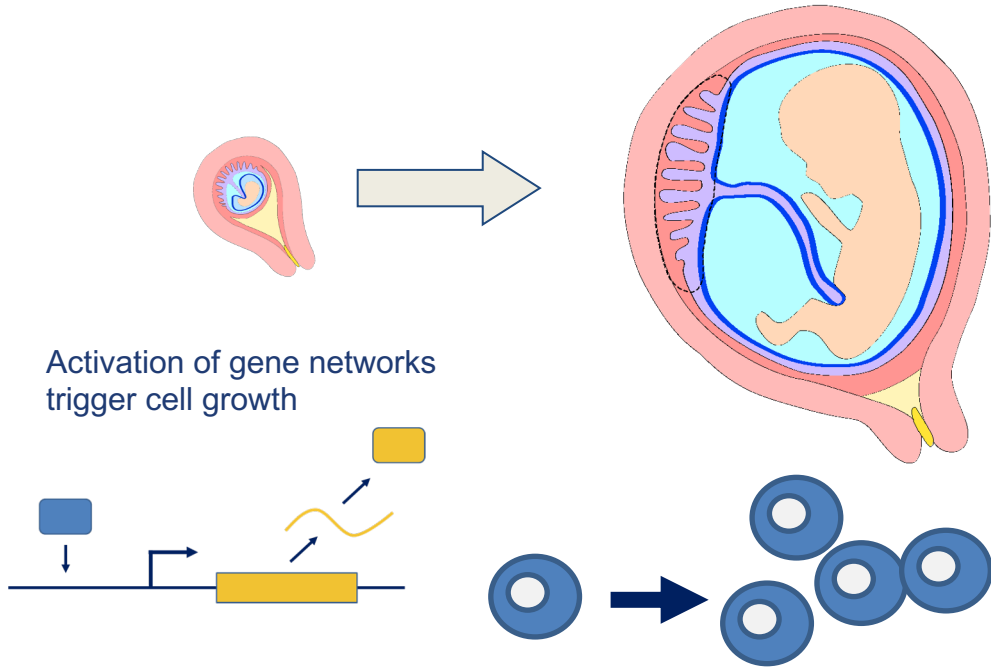


How do cells solve the tissue expansion problem?

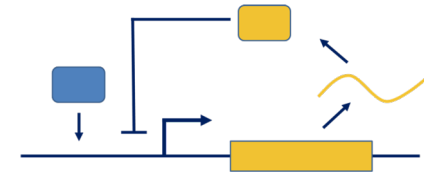


How do cells know when
to stop?

How do cells solve the tissue expansion problem?



How do cells know when to stop?



Feedback!



Feedback across multiple scales

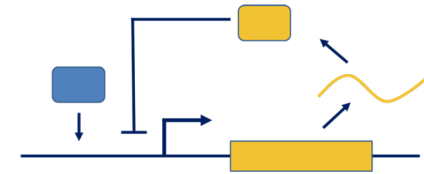
How do cells solve the tissue expansion problem?



Opportunity to reframe the way students think about engineering goals:

- Less emphasis on “speed, strength and toughness, and Six Sigma reproducibility”
- Greater emphasis on “cooperation, the noise and variability as a value, probabilistic (vs. deterministic) differentiation strategies, feedback to achieve balance and sustainability with the environment, symbiosis”

How do cells know when to stop?



Feedback!



Feedback across multiple scales

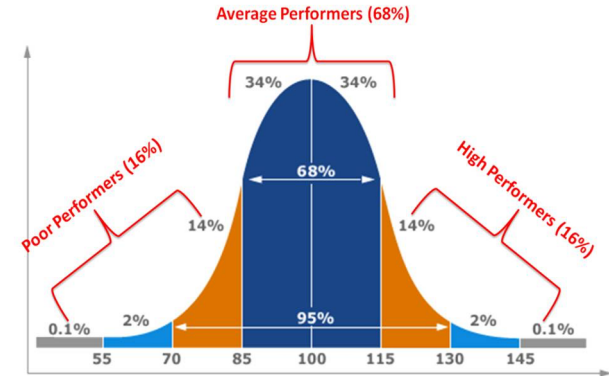
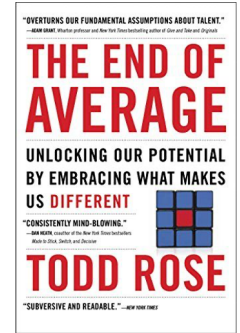
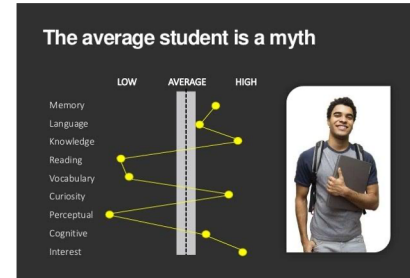


How do cells solve the tissue expansion problem?

Opportunity to reframe the way students think about engineering goals:

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- Greater emphasis on “cooperation, the noise and variability as a value, probabilistic (vs. deterministic) differentiation strategies, feedback to achieve balance and sustainability with the environment, symbiosis”

And human performance!



More than the sum of its “parts”

The HeLa cell line as a model of cell growth

- On Oct. 4, 1951, Henrietta Lacks died of cervical cancer at Johns Hopkins University Hospital
- Part of the cancer was broken down into individual cells and cultured
- An epithelial-like subset of these cells grew in culture, and became the first human cells shown to divide endlessly *in vitro*



How have HeLa cells changed basic biology research?

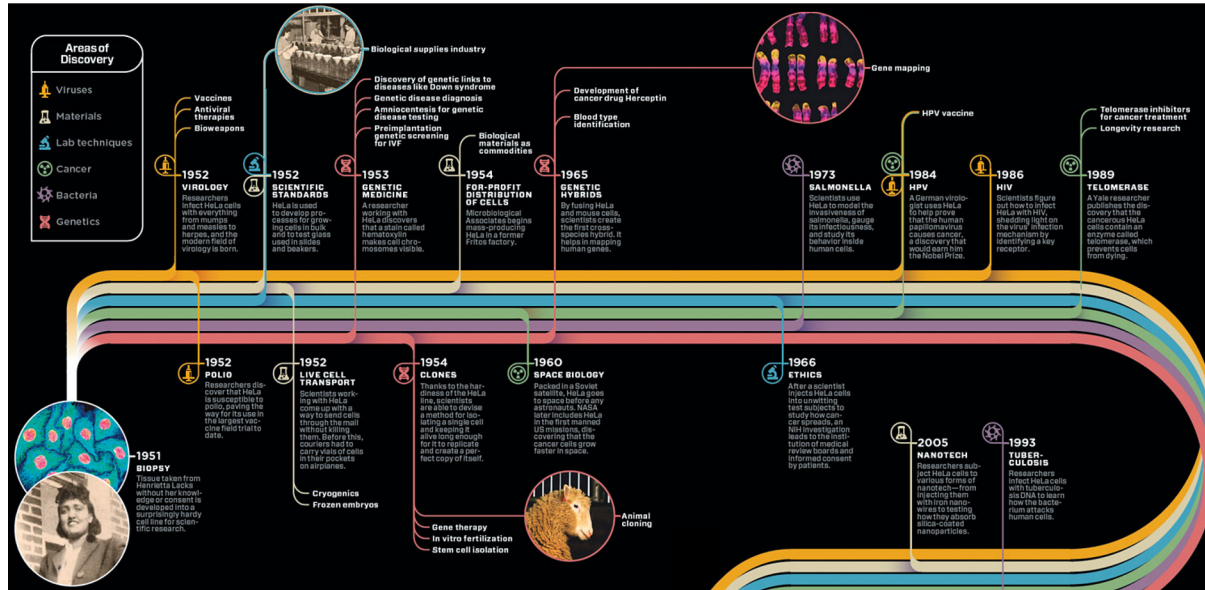
What are some of the bioethics questions that human cell and tissue research raises?

Tissue Engineering (BME 160)



More than the sum of its "parts"

The Impact of HeLa Cells on Science

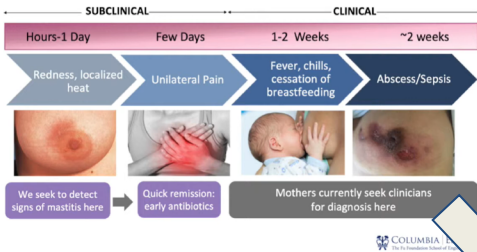


http://www.wired.com/magazine/2010/01/st_henrietta/



Integrated curriculum across IMWEL institutions towards development of a new engineering concentration in Women's Health and Mechanobiology

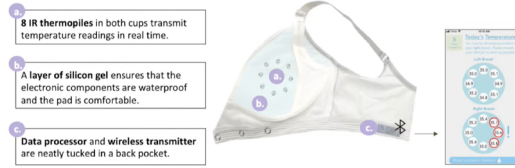
Timeline and Deficit of Care



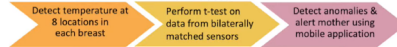
2019 BME capstone design team @CU:
The Hera Bra for Detection of Subclinical Mastitis in Breastfeeding Mothers

Finalist at the NIH Design by Biomedical Undergraduate Teams (DEBUT) Challenge Winners

Our Solution: Hera Smart Bra



The Process



COLUMBIA ENGINEERING
The Graduate School of Engineering and Applied Science

Rachel Mintz from the HERA Bra team, Now a MD-PHD student at WashU, working in the lab of Prof. Christine O'Brien (an IMWEL engineer).

"I am interested in either becoming an oncologist focused on female malignancies or a gynecologist-oncologist, so women's health is definitely still on my mind"



Christine King, UCI

Biomedical Engineering,
Engineering Education,
Health Systems

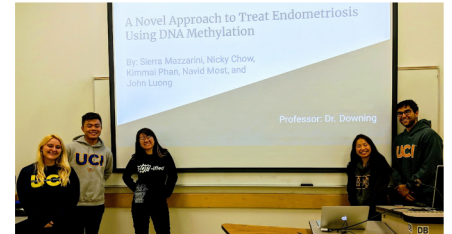


Senior Design @UCI (BME 199)



Aaron Kyle, Duke

Biomedical Engineering,
Engineering Education,
STEM Outreach, Medical
Device Design
Biomedical
Instrumentation and
Signal Processing



Genetic Engineering and Synthetic Biology @UCI (BME 114)

- Final project focused on using synthetic biology to treat endometriosis

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NSF Advance-inspired tools for search committees, hiring managers and labs to reduce implicit bias and promote equity, diversity, and inclusive climates.



Inclusive Curriculums and Interventions for High School



Michelle Oyen, WUSTL

Biomedical Engineering,
Material Science,
Mechanobiology of
Implantation, Fetal
Membrane Mechanics

**Textbook development by
Oyen & Myers, *Expecting
Ingenuity: Human Pregnancy
through an Engineering Lens***

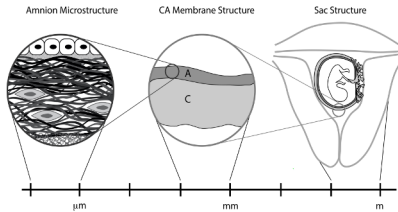


Figure 1: Multi-scale view of the fetal membranes

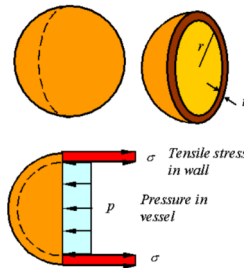


Figure 2: Caption



Kristin Myers, CU

Mechanical Engineering,
Mechanics of Soft Tissues,
Preterm Birth, Hydrated
Biomaterials

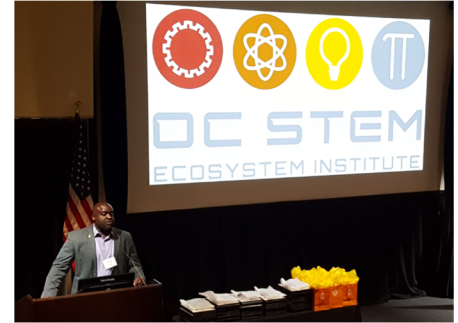


NSF Research Experience
for **TEACHERS (RET)**

NSF 21-606

K-14 educators will enhance their scientific disciplinary knowledge in engineering or computer science and translate their research experiences into classroom activities and curricula to broaden their students' awareness of and participation in computing and engineering pathways.

At the same time, the hosting research faculty will deepen their understanding of classroom practices, current curricula, pedagogy, and K-14 educational environments.



**OC STEM
INITIATIVE**



Outcomes: 2019-20

- 1,500 K-12 students participated in academic programs
- 245 K-12 students attended our summer camps
- 280 educators in 23 Orange County school districts participated in professional development programs, workshops and trainings

Mission

The OC STEM Initiative strengthens the educational pipeline in Orange County by promoting competencies in science, technology, engineering and mathematics (STEM) through a collaborative network of public and private partnerships

Equip Educators

Ecosystem Institute – Workshops and trainings for K-12 educators that focus on open-ended experiential learning and provide educational modules and curriculum that can be broadly disseminated.

Research Experiences for Undergraduates (REU)

Research and Mentorship

These programs mentor undergraduate students from underrepresented groups interested in conducting undergraduate research and/or attending graduate school.

Cultivating the IoT-Enabled Smart Community (IoT-SITY):

<https://sites.uci.edu/iotsity/>

UC-HBCU Initiative: Pathways to Accelerate Computing and Engineering Doctorates (PACE):

<https://sites.uci.edu/uciaamupathways/>

Research Exploration Workshop on IoT and Privacy:

<https://sites.uci.edu/explorecsrworkshop/>
(in collaboration with [ProperData](#))

Pathways to Computing for Women of Color

(New program!)



Our REU will give students the opportunities to conduct research in IMWEL labs at any of the four institutions across two summers

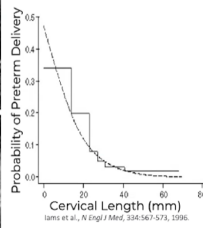
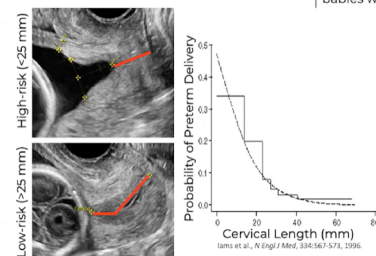
The Effect of Maternal Anatomy Parameters on Loading of the 2nd Trimester Cervix



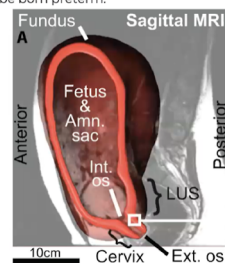
Jada Hinds

Myers Soft Tissue Lab
Columbia University, New York, NY

Background



The mechanics of pregnancy are not well understood, making it difficult to predict when babies will be born preterm.



MYERS SOFT TISSUE LAB

Fernandez et al., *CMBBE*, 2015.
COLUMBIA ENGINEERING
The Frederick S. Lee School of Engineering and Applied Science

CU and Amazon Summer Undergraduate Researcher Experience (SURE), 2021

Pathways to Opportunities in Women's Health

Identify and promote IMWEL Rising Stars in Engineering in Women's Health

The **Rising Stars in Engineering in Health** program was created in 2020 by Columbia Engineering and Columbia Medicine to educate, train, and **empower** emerging leaders in academia at the intersection of engineering and biomedicine.

Selected from approximately 200 talented postdocs, researchers, and senior graduate students across the country.

Rising stars attend a two-day intensive training workshop and all program applicants are invited to attend virtually the educational portions of the workshop.



2021 Rising Stars in Engineering in Health

Pathways to Opportunities in Women's Health

Graduate
Research within
IMWEL
Ecosystem



Kristin Myers, CU

Mechanical Engineering, Mechanics of Soft Tissues,
Preterm Birth, Hydrated Biomaterials



X. Edward Guo, CU

Biomedical Engineering, Mechanics of Soft Tissues,
Preterm Birth, Hydrated Biomaterials



Kyoko Yoshida, PhD

Assistant Professor
University of Minnesota, BME

Pregnancy Research & Engineering Group



Xiaowei Sherry Liu, PhD

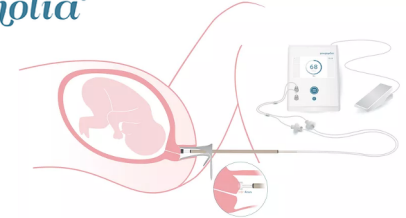
Associate Professor
University of Pennsylvania, Orthopaedic Surgery



DR. MICHAEL FERNANDEZ

Senior Scientist / Technical
Product Manager

pregnolia[®]



Effects of Pregnancy, Lactation, and Weaning
on Maternal Bone

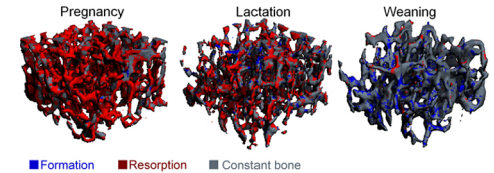


Fig 9. Bone remodeling taking place during pregnancy, lactation, and weaning. Newly formed bone is shown in blue, while lost bone is shown in red.

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Cultivate Inclusive Leadership and Mentorship



ADVANCE Program
FOR EQUITY & DIVERSITY
Expect Equity, Support Diversity, and Practice Inclusion.

The mission of UCI ADVANCE is to promote an inclusive culture for faculty and graduate student excellence.

Equity advisors and graduate program DECADE mentors carry out this mission.

Peer to peer collaboration designed to advance excellence through an intentional commitment to equity and diversity in three areas critical for the success: (i) recruitment and admissions, (ii) advancement and degree completion, and (iii) an affirmative climate for all faculty and graduate students.

Equity advisors establish best practices to promote faculty diversity and inclusion across campus.



Wendy Liu, UCI

Biomedical Engineering, Chemical & Biomolecular Engineering, Materials & Microfabrication, Regulating Cell Behavior, Multicellular Behavior, Cardiovasculature



Timothy Downing, UCI

Biomedical Engineering, Tissue Engineering, Regenerative Biology, Mechanobiology



Course piloted in June of 2021

Developed and specifically targeted towards Engineering faculty, graduate students and staff



UCI Susan & Henry Samueli College of Health Sciences **UCI Samueli** School of Engineering **UCI** Office of Inclusive Excellence

EMPATHY & INTERCONNECTEDNESS: THE PATH FORWARD

Live Online with Psychiatrist Dr. Monisha Vasa & Mindfulness Expert Cayce Howe

Define & develop foundations of mindfulness, compassion, self-compassion, & empathy

Deepen our understanding of why empathy is critical in improving our relationships with ourselves & those around us

Learn skills of deep active listening & practices of actively cultivating empathy & compassion

JUNE 22 - JULY 27, 2021
TUESDAYS 7:00-9:00 PM

AT NO COST, OPEN TO 30 UC IRVINE GRADUATE STUDENTS, STAFF, & FACULTY



What does inclusive excellence look like for IMWEL?

Microchimerism in the Mother(land): Blurring the Borders of Body and Nation

ARYN MARTIN

Abstract This article traces the ubiquitous geopolitical metaphors used by researchers in the field of pregnancy-related microchimerism. In this research domain, immunologists and medical geneticists locate 'non-self' cells in women by marking Y chromosomes in cells derived from their sons. In the course of this research trajectory, experiments have yielded a number of surprises, beginning with the very presence of these cells in women decades after pregnancy. This finding confounded the expectations predicted by classical immunology, which posits the destruction of such 'foreign' entities. Once they were known to be present, fetal cells were implicated in pathological and destructive activity. In a series of reorientations in which metaphor, theory and practice are entangled with matter, the characterization of these cells has shifted from invaders to insurgent foreigners to assimilated productive immigrants. The article reflects on this rich domain of material-semiotic practice to demonstrate that the case of fetomaternal cell trafficking contributes to a growing uneasiness with dominant ontologies of bodies as bounded, defended, pure collectives of homogeneous inhabitants.

Keywords cell biology, immigration, immunology, materiality, metaphor, pregnancy, science studies

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Vol. 16(3): 23-50; DOI: 10.1177/1357034X10373404

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Microchimerism in the Mother(land): Blurring the Borders of Body and Nation

ARYN MARTIN

Abstract This article traces the ubiquitous geopolitical metaphors used by researchers in the field of pregnancy-related microchimerism. In this research domain, immunologists and medical geneticists locate ‘non-self’ cells in women by marking Y chromosomes in cells derived from their sons. In the course of this research trajectory, experiments have yielded a number of surprises, beginning with the very presence of these cells in women decades after pregnancy. This finding confounded the expectations predicted by classical immunology, which posits the destruction of such ‘foreign’ entities. Once they were known to be present, fetal cells were implicated in pathological and destructive activity. In a series of reorientations in which metaphor, theory and practice are entangled with matter, the characterization of these cells has shifted from invaders to insurgent foreigners to assimilated productive immigrants. The article reflects on this rich domain of material-semiotic practice to demonstrate that the case of fetomaternal cell trafficking contributes to a growing uneasiness with dominant ontologies of bodies as bounded, defended, pure collectives of homogeneous inhabitants.

Keywords cell biology, immigration, immunology, materiality, metaphor, pregnancy, science studies

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Polly Matzinger

From “self vs. other” to “danger signals” as a model for immunity

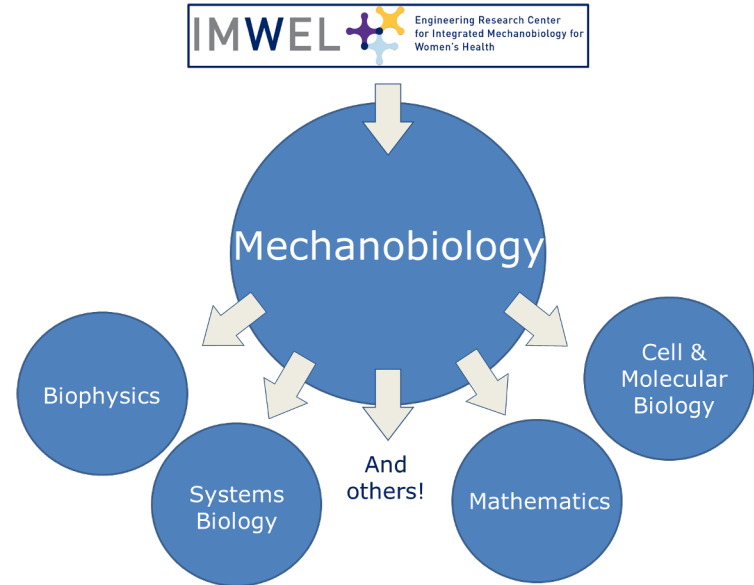


Mina Bissell

How mechanical information within the cell’s environment drives cancer malignancy

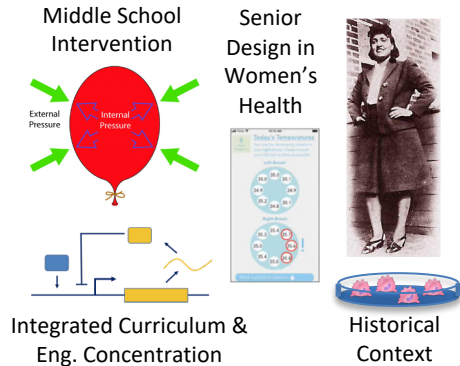
The Impact of Women's Health on the Mechanobiology

- Mechanobiology is highly interdisciplinary
- IMWEL researchers and trainees will form connections beyond engineering
- The integration of Women's Health and Mechanobiology within the EWD/DCI ecosystem will change thinking across disciplines



Goals and Milestones

Design and test educational interventions



Establish pathway programs in Women's Health

Jada Hinds
Myers Soft Tissue Lab
Columbia University, New York, NY

RISING STARS IN ENGINEERING IN HEALTH

Research Experience for Undergraduates

NSTI RET

Textbook Development

Graduate Research within IMWEL Ecosystem

Figure 1: Multi-scale view of the fetal membrane

Build a culture of inclusive leadership and mentorship

ADVANCE Program FOR EQUITY & DIVERSITY
Expect Equity, Support Diversity, and Practice Inclusion.

Disseminate best practices in hiring and retention

Mentorship training

CIMER Center for the Improvement of Mentored Experiences in Research

CORO NORTHERN CALIFORNIA Leadership training

EMPATHY & INTERCONNECTEDNESS: THE PATH FORWARD

Programs to Cultivate Empathy & Interconnectedness

YEARS 1-2

- Complete educational intervention studies in initial set of middle schools
- Establish RET and develop new high school interventions and curriculum
- College curriculum interventions
- Select Inaugural class of IMWEL postdocs

YEARS 3-5

- Select Inaugural IMWEL Rising Stars in Engineering in Women's Health
- Establish inclusive hiring, retention, and mentorship best practices across IMWEL ecosystem
- Foster REU participation across all IMWEL locations

YEARS 5-10

- Scale an integrated college curriculum and new Women's Health concentration at all IMWEL universities
- Deploy a empirically proven set of interventions that build an informed, effective, and robust engineering workforce.



“

I was always interested in physics and chemistry in high school. If we studied things like pregnancy and the biomaterial that holds a baby, I would probably be an engineering major today.”

Chiamaka Okonkwo, Research Assistant for EWD/DCI
classroom intervention project.
December 2, 2021

”



DCI/EWD Outline




- I. DCI/EWD: Overarching Goals and Conceptual Framework
- I. EWD: Preparing Future Generations of Engineers
- I. **DCI: Fostering and Sustaining an Inclusive Organizational Climates**



Diversity, Culture and Inclusion






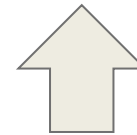
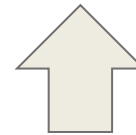
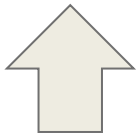
Evidence-based strategies

VISION	 Diverse and inclusive center climate		 Next generation of engineers			 Multi-dimensional understanding of engineering challenges		
STRATEGY	Inclusive climate within & across labs & research thrusts	Community & student board engagement	Inclusive hiring & retention	Educational intervention	Cultivate & support pathway programs	Visibility of historic & current challenges related to gender & intersectionality	Seed grants	Create accountability structures



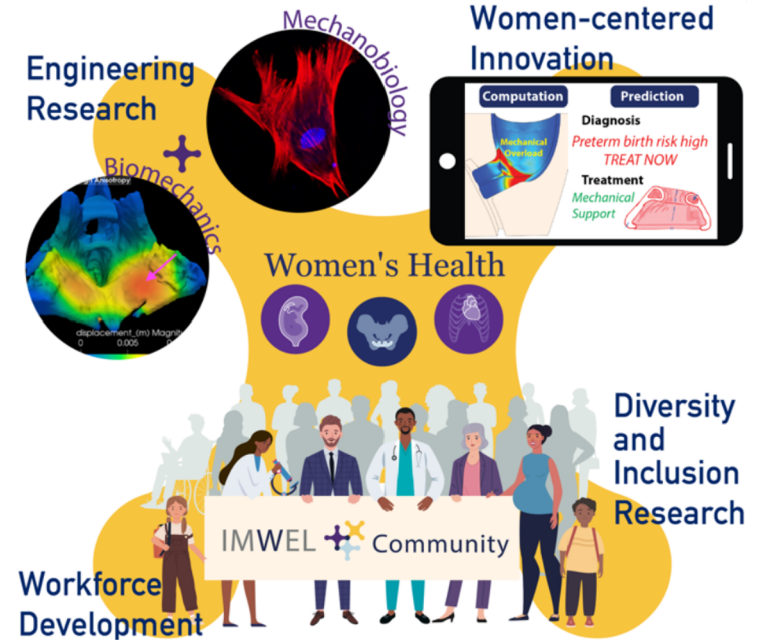
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DCI Grand Challenge

Sustained attention to evidence-based best practices is needed to foster, sustain and enhance a diverse, equitable and inclusive IMWEL climate.



Our team spans disciplines and schools



Valerie Purdie-Greenaway, CU

Psychology, Organizational Behavior,
Interventions to Reduce Stereotype Threat,
Diversity Science



Timothy Downing, UCI

Biomedical Engineering, Tissue
Engineering, Regenerative
Biology, Mechanobiology



Wendy Liu, UCI

Integrations, Biomedical
Engineering, Chemical &
Biomolecular Engineering,
Materials & Microfabrication,
Regulating Cell Behavior,
Multicellular Behavior,
Cardiovasculature



Maritza Salazar Campo, UCI

Team Science, Group dynamics
and processes, Team-based
organizations, Impact of
culture on work behavior,
International management,
Management of innovation and
learning



Harry West, CU

Mechanical Engineering,
Industrial Engineering and
Operations Research, Product
Design Methodology, Service
and Experience Design



Naomi Chesler, UCI

Biomedical Engineering,
Cardiovascular Mechanobiology &
Biomechanics, Engineering
Education, Diversity, Equity &
Inclusion in STEM



Michelle Oyen, WUSTL

Biomedical Engineering, Material
Science, Mechanobiology of
Implantation, Fetal Membrane
Mechanics



Daniel Stokols, UCI

Team Science, Environmental
Psychology, Social Ecology,
Sustainability, Public Health



**Sue Giancola, University of
Delaware**

External Evaluator



Steven Abramowitch, Pitt

Bioengineering, Computational
Modeling of Pelvic Floor, Soft
Tissue Characterization, Vaginal
Mesh Design

Existing Resources and Programs



Columbia University (CU):

- Bridge to the PhD post-baccalaureate program (NSF supported)
- Columbia World Projects: Leveraging Policy to Improve Maternal Health in the Fourth Trimester
- Safe Motherhood Initiative Department of Obstetrics and Gynecology
- International Center for AIDS Care & Treatment

University of Pittsburgh (Pitt):

- STRIVE program (an NSF AGEP program)
- Community Engagement Centers
- CampBioE
- Workforce Development Committee of the Institute of Politics
- Youth Education and Workforce Development

University of California, Irvine (UCI):

- Bridge to the Doctorate Program (an NSF LSAMP program)
- Minority Science Programs
- UC LEADS (Leadership Excellence through Advanced Degrees)
- Student Achievement Guided by Experience Scholars Program

Washington University in St. Louis (WUSTL):

- Strategic research focus on Women's Health: Center for Women's Health Technology
- New center supporting Women in Engineering & Technology
- Equalize program—women entrepreneurs and investors mentoring women entrepreneurs
- WU Summer Engineering Fellowships (WUSEF) promoting research careers for URM students

What are the primary activities of DCI?



Seed Grants

Commit to a seed grant program where research can seek small amount of funds to diversify their samples and and/or analytic strategies



Community engagement plan

Authentically engage with the communities at each institution.



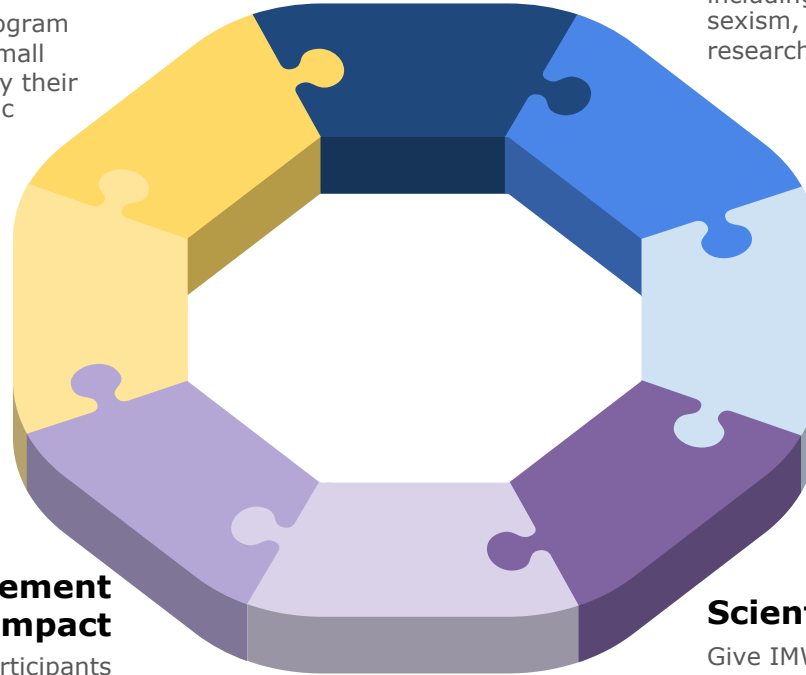
Product Design

Equip participants with the language and frame for addressing critiques about how to be gender and racially inclusive.

Community engagement impact



Give IMWEL participants tools for thinking about how to engage community in our work.



Provide historical context

This context will be provided over the life of the grant, including history of racism, sexism, and otherism in research on women's health



Clearinghouse of contemporary information

What do we know about health disparities and life circumstances of women today?



Inclusive Glossary




Introduce glossary of inclusive common terms for IMWEL (e.g., woman vs. birthing people)




Scientific inclusion

Give IMWEL participants tools for thinking about sampling, methods, analyses and interpretation of their own analysis



	 Diverse and inclusive center climate	 Next generation of engineers	 Multi-dimensional understanding of engineering challenges					
Type of Strategy	Inclusive climate within and across all laboratories and research thrusts	Community and Student Board Engagement	Inclusive Hiring and retention	Design and test educational interventions	Cultivate and support pathway programs	Visibility of historic and current challenges related to gender, intersectionality	Seed grants	Create accountability structures
Rationale (Relevance to IMWEL Center)	Labs are home bases for scientists and thus lab climate has outsized impact on overall IMWEL climate.	Ensuring integration of community and students as stakeholders is key to all aspects of IMWEL success.	Trainees and faculty hired today will shape the institution and the field in years to come.	Transforming the way young people think about the kinds of problems engineers solve will be critical to developing next gen engineers.	Individuals need to gain specialization, and mentorship within subfields of engineering in order to nurture their careers and support next gen of engineers.	Ending systemic racism in science and forging a more inclusive science require those in the system, including <i>IMWEL</i> , to collectively acknowledge and study these facts.	Incentivizing scientists to incorporate inclusive approaches will advance scientific discoveries	Scientific inclusion accountability structures situates IMWEL as scientific leaders in engineering and women's health.
Purpose (Objectives of the strategy)	Leverage team science to foster communication, fair collaboration practices, and shared purpose while cultivating belonging and psychological safety.	Develop and foster structures that will transcend conventional isolated discipline focused boundaries	Ensure that hiring managers have tools to to reduce implicit bias and that labs have tools for inclusive climate	Develop, test refine and disseminate educational curriculum appropriate for a range of ages that holds relevance for engineering.	Offer high school, undergraduate, graduate, and postgraduate training opportunities. Offer pedagogical tools to teachers and faculty.	Drawing sustained attention to societal and structural challenges related to women, gender and intersectionality will motivate scientists to probe their own data and methods.	Provide resources to enable collaborative dialogue, action, and insight for systemic change towards racial equity.	Forging a more inclusive science requires identifying and correcting potential inequities in publication, product design and diagnostic tools.
Example	Team science collaboration planning sessions.	Co-Collaboration product design meetings.	Web0-based clearinghouse of simple best-in-class strategies.	RCT on pregnancy and the uterus.	RET (Research Experience for Teachers) Program	Transdisciplinary publications documenting systemic racism in scientific literature related to each testbed.	Annual seed funding competition	Designated team to read publications before final submission.

	 Diverse and inclusive center climate		Develop future generation of bioengineers			Inclusion and anti-racism as integral to the scientific method		
Type of Strategy	Inclusive climate within and across all laboratories and research thrusts	Community and Student Board Engagement	Inclusive Hiring and retention	Design and test educational interventions	Cultivate and support pathway programs	Visibility of historic and current challenges related to gender, intersectionality	Seed grants	Create accountability structures
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	Leverage diversity of IMWEL center testbeds		Develop future generation of bioengineers			Inclusion and anti-racism as integral to the scientific method		
Type of Strategy	Inclusive climate within and across all laboratories and research thrusts	Community and Student Board Engagement	Inclusive Hiring and retention	Design and test educational interventions	Cultivate and support pathway programs	Visibility of historic and current challenges related to gender, intersectionality	Seed grants	Create accountability structures
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Team science model and measurement

- **Measure effectiveness of team science on multiple levels:** individual team, impact of research, effectiveness of team science funding programs, etc.
- **Measure key constructs** (e.g. collaboration, disciplinarity, team effectiveness, personal/behavioral characteristics, team processes, readiness, synergy, productivity, shared knowledge).
- **Measure the relationship between productivity and the composition of teams.**
- **Compare the effects of team science versus traditional science in advancing scientific knowledge.**

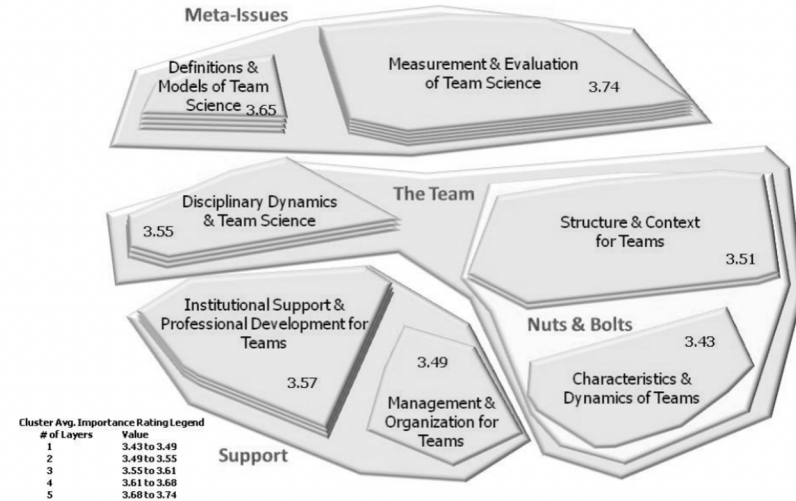


Figure 2. SciTS concept map

Note: A comprehensive SciTS issues map showing labeled clusters and regions. Synthesized SciTS topic statements (refer to Figure 1) are no longer shown as individual points; rather, they are now grouped and represented by clusters (7), and then by regions (4). The average importance rating for each cluster is displayed inside the clusters

DCI/EWD: Measurement

DCI and EWD will measure **products** and **processes** across the IMWEL eco-system.

The measures will be **explicit** and **implicit**.



TEAM
SCIENCE



INNOVATION
ECO-SYSTEM



DCI
SELF-STUDY

Integrating measurements across these three categories will allow IMWEL to effectively assess success, maintain accountability, and disseminate findings and best practices.

Implications of EWD/DCI



2021 **WORKING PAPER** HBS WORKING PAPER SERIES

Who Do We Invent for? Patents by Women Focus More on Women's Health, but Few Women Get to Invent

By: [Rembrand Koning](#), Sampsa Samila and John-Paul Ferguson

Format: Print | Language: English | Pages: 45

 Email  Print  Share

 Recommend 0

 Share

ABSTRACT

Has the increase in female medical researchers led to more medical advances for women? In this paper, we investigate if the gender of inventors shapes their types of inventions. Using data on the universe of U.S. biomedical patents, we find that patents with women inventors are significantly more likely to focus on female diseases and conditions. Consistent with the idea of women researchers choosing to innovate for women, we find stronger effects when the lead inventor on the patent is a woman. Women-led research teams are 26% more likely to focus on female health outcomes. This link between the gender focus of the scientist and the type of invention, in combination with the rise of women inventors, appears to have influenced the direction of innovation over the last four decades. Our findings suggest that the demography of inventors matters not just for who invents but also for what is invented.

Goals and Milestones

Leveraging diversity of center, testbeds, & community and establishing a culture of inclusion

Community engagement and community impact plan, including community boards and student boards



Ongoing programs to provide historical context to racism, sexism, and otherism in research on women's health



Coupled inclusive hiring and retention practices

Diversity, equity, inclusion & anti-racism as integral to the scientific method

Seed grants across IMWEL ecosystem



Inclusive laboratory best practices and institutional accountability structures



Established best practices for convergent science

Shared vocabulary regarding inclusion and women's health

Equity, Diversity, and Inclusion

INCLUSIVE LANGUAGE GUIDELINES



YEARS 1-2

- Established community and student boards
- Implemented scientific inclusion best practices and accountability structures across IMWEL, focused on people, psychological safety, institutional leadership, & ongoing training.

YEARS 3-5

- Established inclusive hiring, retention, and mentorship evidence-based best practices across IMWEL ecosystem
- Founded seed grant programs to incentivize inclusive research
- Created a blueprint for other centers involved in convergence science.

YEARS 5-10

- Developed & disseminated glossary of inclusive terms and concepts, creating a shared vocabulary related to inclusion and women's health
- Produced more patents than any comparable center with women and URMs as patent holders.
- Produced publications, grants & awards that show increase in the inclusion of scientific inclusion methods.



“ I was always interested in physics and chemistry in high school. If we studied things like pregnancy and the biomaterial that holds a baby, I would probably be an engineering major today.”

Chiamaka Okonkwo, Research Assistant for EWD/DCI
classroom intervention project.
December 2, 2021

DCI & EWD
Q&A

