Combining Forces: Putting Equity to Work

Dr. Fatima Alleyne, University of California, Berkeley

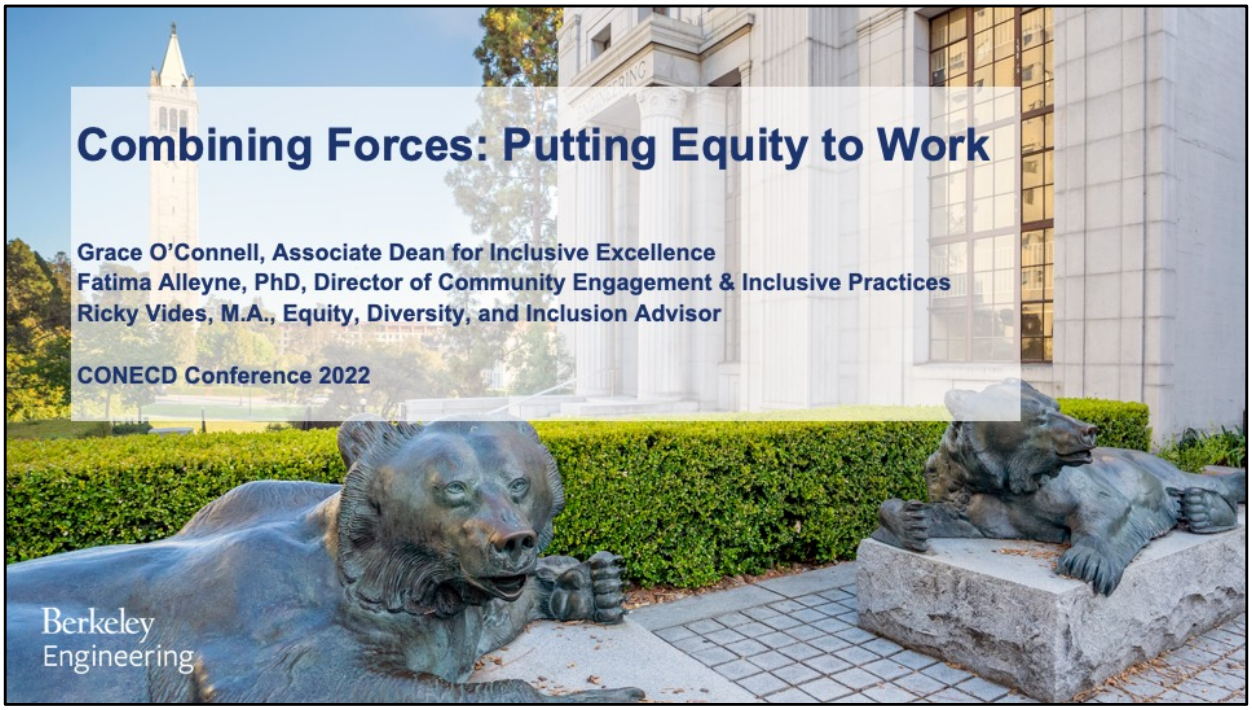
Fatima Alleyne, Ph.D., is the director of Community Engagement and Inclusive Practices in the College of Engineering at UC Berkeley. She brings her passion and love for science, technology, engineering and math (STEM) and education into her work to develop programs that promote equity; foster a positive, inclusive culture; and increase access and opportunities to those who have historically been underrepresented in STEM. She also leads a strategic planning and data-driven process to guide programs and priorities to advance diversity, equity and inclusion in the College. Fatima earned her Ph.D. and M.S. degrees in materials science and engineering from UC Berkeley and a B.A. in chemistry from City University of New York, Hunter College.

Mr. Ricky Vides, University of California, Berkeley

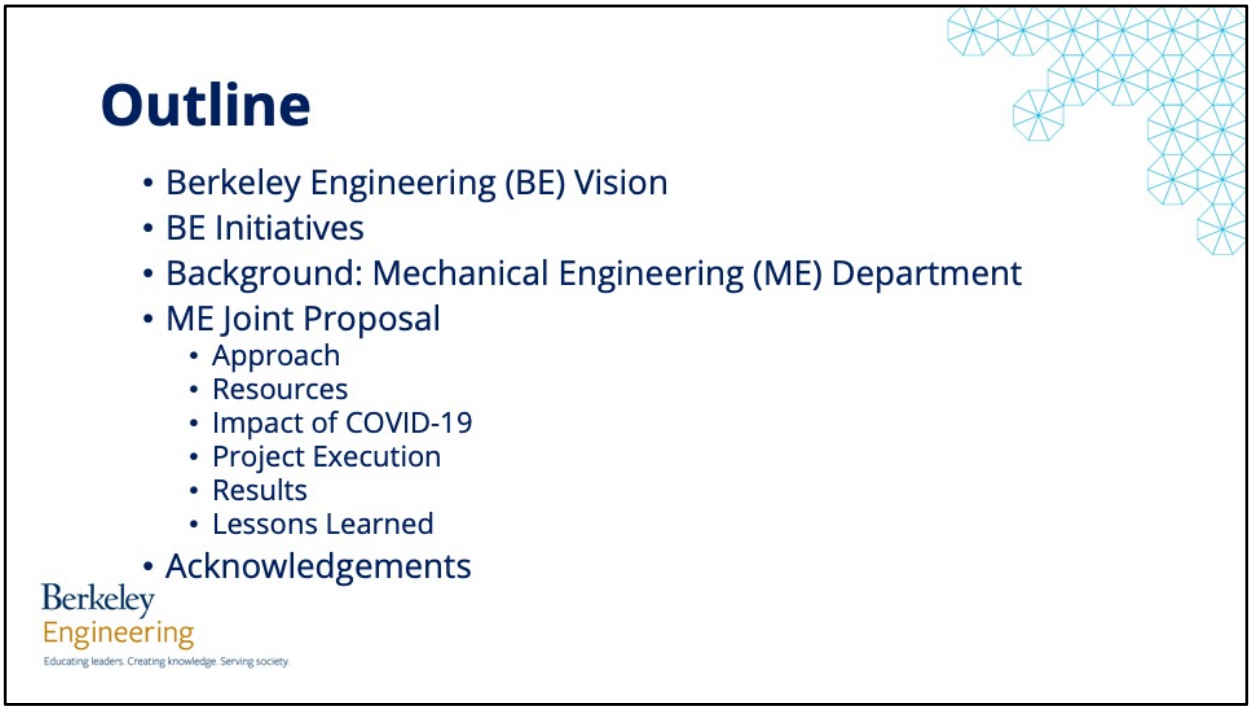
Ricky Vides is the Diversity, Equity, and Inclusion advisor in the Department of Mechanical Engineering at the University of California, Berkeley. He is also the staff director for the Combining Forces: Putting Equity to Work project. Ricky Vides is an alumnus of the University of California. He also received advanced degrees in Higher Education Student Development and Marriage and Family Therapy from Saint Mary's College of California.

Prof. Grace D O'Connell, University of California, Berkeley

Grace O'Connell is the Associate Dean for Inclusive Excellence in the College of Engineering and Associate Professor in the Department of Mechanical Engineering at the University of California, Berkeley. She is the co-director of the Berkeley Biomechanics Laboratory, and her research interests are in soft tissue mechanobiology and tissue engineering. O'Connell received a PhD in Bioengineering from the University of Pennsylvania in 2009, where her research focused on intervertebral disc biomechanics with age, degeneration, and injury. O'Connell's research group employs computational modeling and experimental approaches to study the effect of aging and disease on tissue- and joint-level mechanobiology. She has received many awards including the 2019 YC Fung Young Investigator Award and NSF CAREER Award, and was inducted into the AIMBE College of Fellows in 2021.

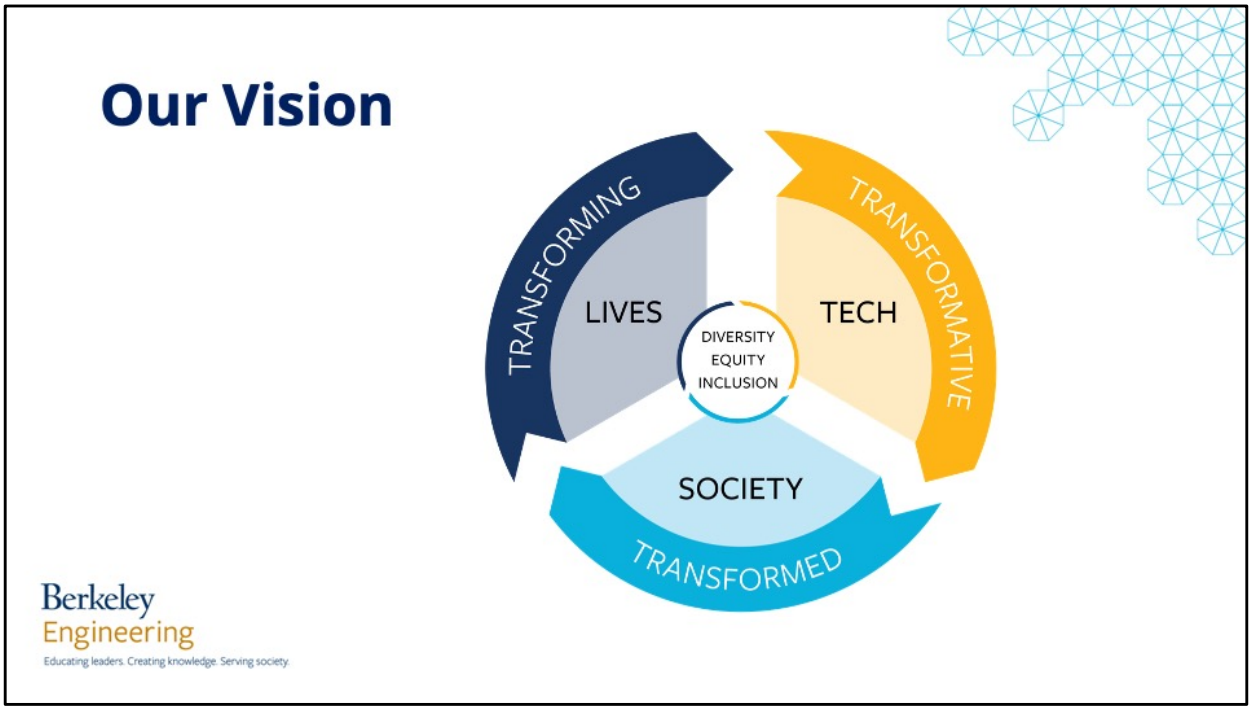


Thank you for joining us today for our presentation on Combining Forces, Putting Equity to Work. My name is Dr. Fatima Alleyne and I am the Director of Community Engagement and Inclusive Practices in the College of Engineering at UC Berkeley. Joining me today from UC Berkeley is Professor Grace O'Connell, the Associate Dean for Inclusive Excellence and former Vice Chair for Equity in the Mechanical Engineering Department and also from the Mechanical and Engineering Department, Ricky Vides, the Equity, Diversity, and Inclusion Advisor.



Today we would like to share a new program created in collaboration and partnership between leaders in the University of California Office of the President (UCOP), Berkeley Engineering also known as BE, and the Mechanical Engineering Department, referred to as ME for the remainder of the talk.

To provide you with a snapshot of our time today, we've prepared an outline as presented here. First we will discuss our dean's vision for BE and an initiative funded by UCOP. We will then share how this initiative led to a myriad of programs/opportunities and ultimately, the development of a joint proposal led by Professor Grace O'Connell, and in collaboration with diverse faculty in the Mechanical Engineering Department. The process undertaken by the faculty to develop and execute this proposal will be described as well as our lessons learned. Finally, acknowledgements will be given to all those who contributed to this work.



The college of Engineering is the 2nd largest college on campus and home to ~250 active faculty, 240 staff, and 6,000 students. At its core, our dean, Dean Tsu-Jae King Liu, is committed to and has prioritized the advancement of diversity, equity, and inclusion.

With this principle in mind, she is leading the charge with the following mission:

CLICK

To **transform the lives** of our students by preparing them to become successful leaders and innovators for positive change.

CLICK

To expand knowledge and create **transformative technology** through original research to tackle the world's biggest challenges.

CLICK

To work toward a **transformed society**, in which all members can thrive, through service to government, industry and the engineering professions.

At the core of our mission are values that drive us to educate **inclusive** leaders and create knowledge **equitably** in service of a **diverse** society.

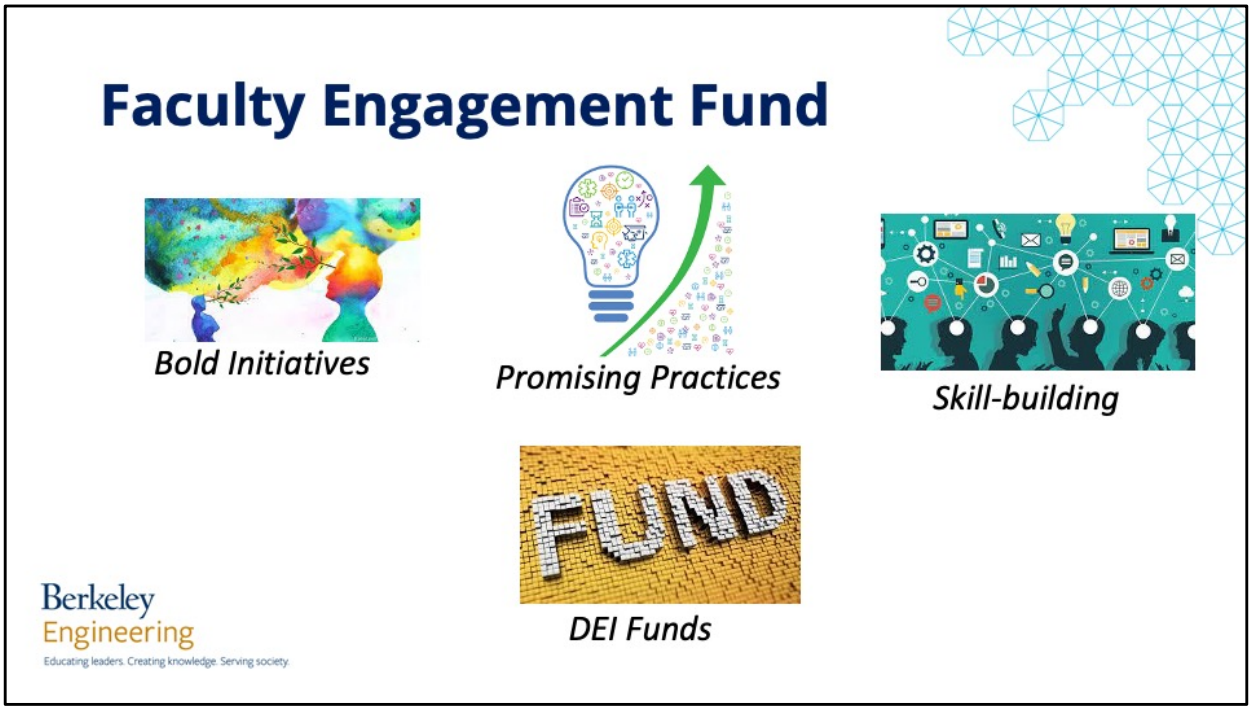
Under the leadership of former Associate Dean Kara Nelson, the College of Engineering submitted a successful proposal to the University of California Office of the President that highlighted Berkeley Engineering's plan to advance the diversification of the professoriate beginning in the 2017-2018 academic year. This proposal outlined a myriad of approaches based on best-practices and promising practices. These approaches included:
CLICK

1. A diversification of our applicant pool in an effort to increase access/opportunities of URMs in academia with the employment of CLICK
2. Rubrics to reduce bias during the evaluation process. CLICK
3. A demonstration of a commitment to or contributions to equity and inclusion prior to appointment via the submission of a diversity statement that outlines their plan to contribute to equity and inclusion on campus. Since the 2017-2018 search cycle, when these 3 practices were adopted, 47 faculty have been hired in the College of Engineering. Of the new hires, 21 identify as female (45%), one as "different" gender identity, 7 as Black/African American (15%), 9 as Asian (19%), and 3 as Middle Eastern (6%). CLICK
4. An increase in professional development opportunities by being intentional about the allocation of funds to support faculty who desire to pursue alternative

training endeavors. This led to 12 of our faculty's participation in such programs as the Faculty Success Program offered by the National Center for Faculty Development and Diversity. CLICK

5. A Cultural Transformation with the appointment of a Director of Faculty Engagement who would advance several initiatives that would EMPOWER our engineers to advance DEI in the College. One approach was the establishment of the Empowering Engineers for Positive Chance also known as the EMPOWER Certificate Program and another was the establishment and management of the Faculty Engagement Fund.

Our intent today is to share how we used the Faculty Engagement Fund to transform the culture in the college and advance DEI at the departmental level.



The establishment of the Faculty Engagement Fund would provide opportunities for faculty in the college to:
CLICK
1. Develop and direct bold large-scale initiatives that engage College of Engineering (CoE) (~300) faculty, (~240) staff, and (~6,000) students, and build literacy around, diversity, equity, and inclusion (DEI) efforts CLICK

2. Establish new programs based on promising practices that complement existing programs CLICK

3. Develop, design, implement, and evaluate professional, career, and skills development trainings, workshops, and other activities that increase interactions among students, staff, and faculty to improve climate – one example is the development of an equity minded syllabi for faculty

CLICK

4. Support faculty in the integration of DEI principles in their teaching, research, and service activities, and in the development of DEI proposals to expand outreach

efforts in K-12 schools, community colleges, and higher education institutions.

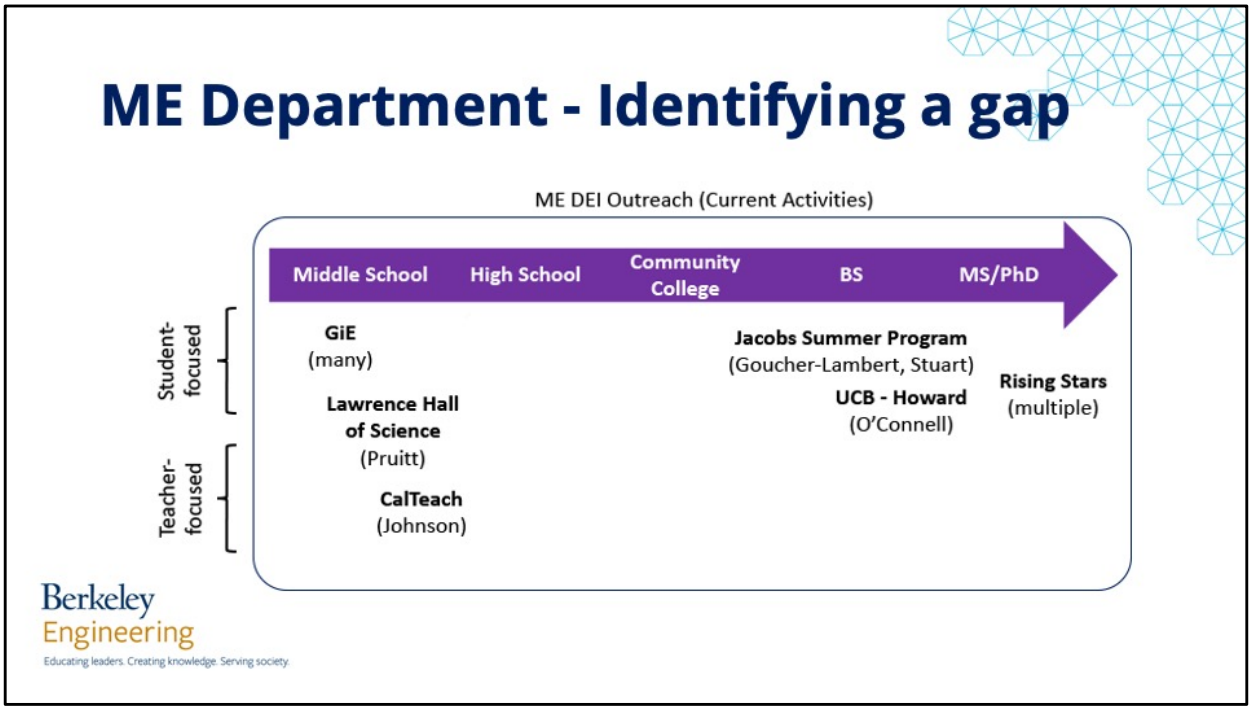
CLICK

These are all funded using funds allocated to the Faculty Engagement Fund with the objective to:

(1) assist COE faculty with the administrative burden of accessing and spending funds on DEI activities while developing outreach ideas to maximize impact;
(2) encourage faculty to partner with each other and existing programs;
(3) track and measure the impact of COE efforts; and
(4) help faculty strengthen their research proposals to external agencies.

Since the program's inception, the FEF has served 7 faculty and 1 department, that spanned K-12 and college level programming, in the development of proposals to advance DEI initiatives totaling approximately half a million dollars. Today we would like to highlight one of these DEI proposals – a joint proposal developed in collaboration with 7 Mechanical Engineering faculty, and led by Professor Grace O'Connell. Professor O'Connell please share more about this proposal.

The Mechanical Engineering Department is the 2nd largest department within the College of Engineering with over 700 undergraduate students and over 400 graduate students. Outreach activities have largely been performed as additional 'service' duties by individual faculty. Programs that faculty participate in range from programs that are organized by external entities or at the college. The most common or well known program in the College of Engineering is the Girls in Engineering program that aims to expose young girls and boys in middle school to careers in engineering and practice engineering/design principles. Other programs have been started by individual faculty -- For example, one of the assistant professors used the individual DEI funds as part of their start up funds to create the Jacobs Hall Summer experience program for undergraduate students at Berkeley.



As the faculty met to discuss the various outreach programs that they or their research group have participated in on a regular basis, we were able to start to map the "pipeline" that we hear so much about in the STEM education literature. We separated out K-12 to better match the schooling separation for children, including middle and high school. This map does not go as far back as elementary school because there were no known activities within the department at the time.

At UC Berkeley and in ME, approximately ⅓ of students transfer into the university during their junior year. The vast majority of these students transfer from California Community Colleges. From there we also looked at programs that were aimed at supporting undergraduate students pursuing their Bachelors of Science degree and finally graduate students, which we have lumped together here for both Masters of Science and PhD students.

Lastly, we separate out programs as being student-focused or teacher-focused. One argument for the importance of running student focused programs is to provide more opportunities for the individual students. However, sustainability of conducting outreach programs is a significant challenge when this work is performed on top of other duties, that receive more weight for promotion -- for example, 'scholarly

scientific research', which I'll address later, and contributing to the department's core teaching mission (BS, MS/PhD).

On the other hand, the teacher-focused program listed here, CalTeach, is a program that invites K12 teachers to spend their summer working in a laboratory to learn about new scientific techniques and skills. It is important to mention that up to 80% of K-12 science teachers in the US do not have a science degree. Thus this program aims to engage and excite K-12 instructors in broader areas of science. The challenge here is the translatability of the skills learned in the lab to their classroom.

CLICK

The real value of performing this exercise was to be able to clearly see the big gap in our collective work. It turned out that ME faculty participated in very few programs that interact with the student population right before entering university -- high school students that might attend college for engineering or community college students that are already pursuing entry level engineering courses.

Every department participates in a 10 year external assessment. The last time my department went through this exercise was a few years ago, before I joined the department. It was not something that I was aware of as a departmental '10 year plan' until I became Vice Chair for Equity for the department. Now, as the Associate Dean I've had the opportunity to review multiple departments' 10 year plans.

Many of these plans discuss the need to recruit a more diverse student body and faculty.

So with the 10-year plan in mind, we looked at how some of these activities would map to the 10-year plan. We saw that the majority of programs are classified under "general outreach", which works towards the overall mission of the University of California, which is to educate Californians and beyond. We had one specific program that has a sub-aim of recruiting students into our program -- The Howard University Summer Research experience, which invites students to spend a summer in research groups at Berkeley.

We also only had one department-wide program that had a built in aim of retention. The literature shows that students that experience research are more likely to stay

within their STEM program. Therefore, the Howard Summer REU could also count towards general STEM retention as it provides students from an institution with limited research opportunities with a chance to apply their classroom knowledge to hands-on research.

Further discussions occurred with a core set of faculty that participated in discussions that shaped the proposal. I was the project lead as the Equity Advisor, which is a role that has existed in the department since 2005 and is constantly evolving, as well as my new role as the inaugural Vice Chair of the Mechanical Engineering Department. Some departments or campuses call the Equity Advisor a different term, Equity Diversity and Inclusion Officer, and their role may be more student focused or department focused.

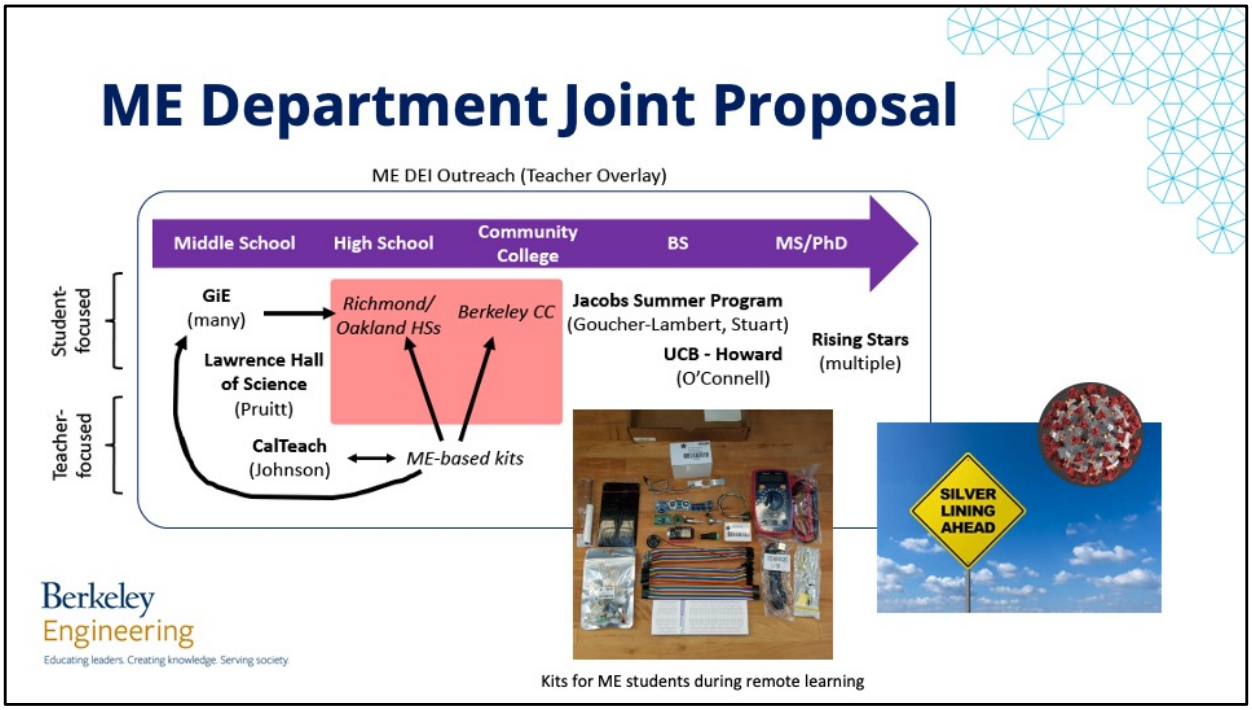
At Berkeley, every department must appoint an Equity Advisor. From the campus level this position has been primarily focused at the faculty level with faculty searches. Thus they are involved with signing off on the process, candidate selection, and distributing the search more broadly to increase the diversity of the applicant pool.

In my roles of Equity Advisor and Vice Chair, I decided to take on a more student centric focus in part by leading this effort, but this does add to my 'unrealized service' work. The rest of the team included two senior faculty members, that did outreach when service received less recognition than it does now in the merit review process. They served as advisors to the program, based on their heavy workloads

elsewhere on campus.

All five co-investigators were assistant professors with a demonstrated interest in outreach programs. It is important to note that two of the five faculty were hired after we employed the best and promising practices as described for our AFDI Initiative. While much of the project has been handled by me as the project lead, it was important to include junior faculty in this process, not only to receive their thoughts and input, but to help develop the long-term culture within the department and share what I hope will be future institutional knowledge gained through this program.

In all, these 8 faculty account for almost 20% of the ME faculty. And an even greater percentage if you account for recent faculty retirements that have occurred since the proposal was submitted in fall 2020.



Kits for ME students during remote learning

The idea that we all came around was to develop ME based curriculum to teach to high school instructors so they could teach students in their classroom. The teach the teacher approach was thought to be more effective in reaching a broader audience.

With equity and access as core principles of this work, the ME department deployed a multi-prong approach: (1) development and execution of professional development opportunities for graduate students and high school teachers, (2) increase high-school student awareness and access to information about mechanical engineering careers and hands-on activities, and (3) enhance recruitment efforts throughout California to fulfill UC Berkeley's commitment as a land grant institution to serve Californians.

We also wanted to be intentional about the potential partner institutions. While the SF Bay Area is well known for its very high cost of living and Berkeley, CA is an area has its fair share of many multi-million dollar homes and a great public school system, there are many communities in its proximity that have schools with limited resources. Thus we intentionally decided to try to partner with instructors in the Richmond area, which is approximately 20 minutes north of Berkeley and Oakland, which borders Berkeley to the south.

What we would actually create would be ME-based hands on kits that teachers could use to share topics that engineers think about and design for. For the outreach part from ME faculty at Berkeley, we would use the model from CalTeach where we teach the teachers then they go off into their classrooms and teach the content to their students where it fits best in their curriculum.

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Mechanical Engineering curriculum consists of multiple hands-on courses that were greatly disrupted during the pandemic. During the summer of 2020, ME faculty worked to pivot these courses into an online format, resulting in an ME kit to be developed and shipped out to individual students. The contents in the kit would provide electronics that would be needed for three of the required core curriculum courses.

We leveraged this idea for the high school project by thinking about how small kits could be packaged and delivered to high school instructors such that their students can work in teams of 2-4 students to build something and learn about career opportunities for mechanical engineers.

While we were primarily focused on developing kits and curriculum content at the high school level, we also realized that there was an opportunity to be able to continue developing the content used in the Girls in Engineering program that is delivered every summer by the college.

Before I joined ME, an outreach relationship was built among UCB's Department of Mechanical Engineering and Richmond High School through a solicitation of mentors for the Ebike competition. Student presence was established by UG student outreach that was already in motion. For this portion of the equity plan, I consider tapping into the work of our students as a point of origin, leveraging the service our students were already involved in was a key element. This led to school visits, and opened connections to establish a long-term partnership with the West Contra Costa Engineering and Manufacturing Advisory Committee. Visiting the neighborhood engineering academy was important. The visit allowed for a examination of resources and processes currently available to future high potential admissions candidates in local secondary education.

Teachers and industry mentors at local Richmond High School requested that I serve on the West Contra Costa Engineering board, which now meets on a quarterly basis and allow students and teachers to present on the status of their engineering academies. While Berkeley is known as an elite research 1A institution, it is important to maintain a level of humility and attention throughout, and recognize what the community needs are in relation to granting access to our institution. We needed to understand them as best we could before we started collaborating, and

listening to students and teachers is a focal point for the WCC Engineering and Manufacturing advisory committee.

The realities of putting equity to work is that there are high and lows in trying to organize the process. One low is that although we had a direct relationship with Richmond High School, this partnership did not come to fruition since their teachers were already overcommitted in their work. However, they are still a point of origin in the project in that through the campus visit to Richmond High school I was connected to become part of Engineering and Manufacturing advising council and was able to recruit the participation of other teachers on the council, teachers from Pinole Valley High School, to serve as partners.

As the momentum grew to work with students and educators outside the Bay Area, we started looking for ways to build collaborations throughout the state. I invited educators to participate from California communities in the following counties: Los Angeles, Monterey, San Diego, the Central Valley. Serving the state in this capacity makes the experience meaningful, and feels like a response that is appropriate for the top ranked public school in our State. In reaching San Diego, similar to connecting with leaders and educators in the Bay Area, we once again tapped into built in connections from our UG Equity, Diversity, and Inclusion student leadership community.

Ultimately, our very own student set up a meeting with 5 educators and 2 administrators from across California: Cathedral College Preparatory High School and Franklin High School in Los Angeles, Helix Charter High School in San Diego, and Pinole Valley High School in Pinole. Again, leveraging the connections held by our students and their sense of service was important.

We are working with 4 partnering secondary institutions.

1. Cathedral High School (part of the Los Angeles Unified School District): Students are traditionally from economically disadvantaged backgrounds, high potential students from downtown and East Los Angeles communities, over 70% of students are on financial aid
2. Franklin Senior High School (Los Angeles Unified School District): 90% of students are economically disadvantaged, high potential students from Northeast Los Angeles.
3. Helix Charter High School (Grossmont Union High School District): Serves high potential students from San Diego Mesa Area, 57% are economically disadvantaged
4. Pinole Valley High School (West Contra Costa Unified School District in Contra Costa County): Serving high potential students from Bay Area in Contra Costa County 59 % high potential economically disadvantaged

There is an administrative cost to equity work. One of the difficult aspects of equity planning is the administration and logistical components of getting people together, whether that is billing and paying for meals, or getting parking passes, and/or booking flights and hotels. COVID gave us some breathing room on that end.

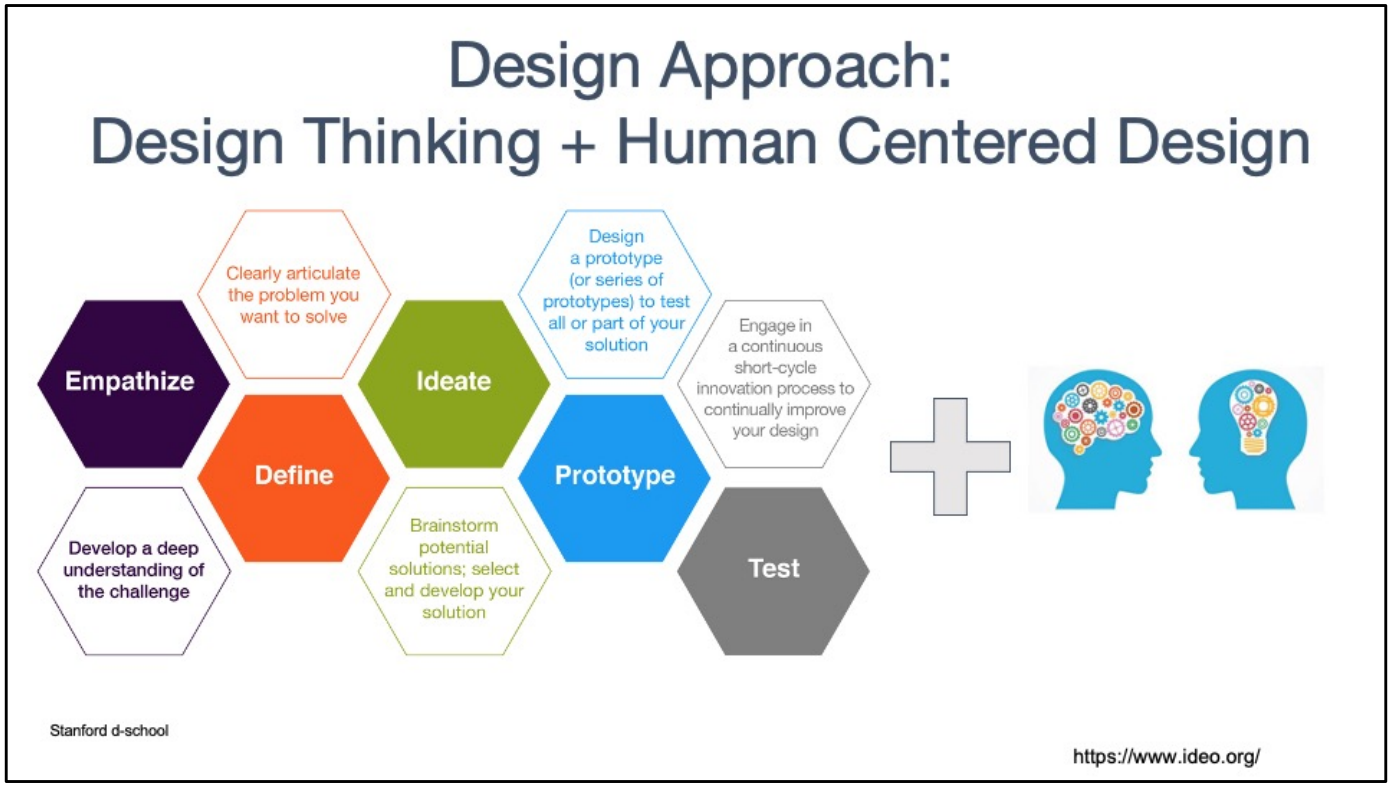
While, we did not reap as much profits as Jeff Bezos during the pandemic, we certainly did benefit from living in the virtual environment. It seems unimaginable to think about how difficult it would be to meet with high school educators during the school year for scheduled in-person meetings. There are some obvious reasons to continue to sustain planning in this particular format, and preserve in-person meetings for vital stages of implementation.

While technology did already exist to bring people together, COVID gave us the opportunity to cease the moment and run with it. Again, COVID humbled us, it forced us to have to go the educators and meet them halfway, without having to physically travel halfway up and down the state. Sometimes it felt like the Zoom was also a neutral setting, while there is glory in sitting physically in a particular space, it does create a different dynamic when you are within the public/private domain of institutions. Being in a neutral space felt like expertise was horizontal, without the

vertical knowledge hierarchies of one particular space over another.

When equity goes to work, it should get paid. With the support of Dr. Alleyne and Professor O'Connell our university, college, and department, now had the platform and funding infrastructure to do more than just visit the secondary space and talk about our institution or our mentoring operations strictly based on the good will of volunteers. This new infrastructure allowed us to also plant the seeds to establish a partnership and sustain a permanent presence. The co-development of a curriculum, hiring educators to consult, and paying for in-classroom materials and lab kits all need to get funded. People are more likely to invest their time when a funding infrastructure is in place.

Creating a culture where there is an incentive structure for making our world a more inclusive place is vital. Professor O'Connell already mentioned how significant it is to have structured long-term objectives in targeting equity goals. Structured funding in our department did not exist before the equity goals were established. The funding of resources is directly related to the ability to highlight important work our faculty and department leaders are involved with, which reciprocates onto major contributions that create and sustain the pipeline of diverse engineers. Dr. Alleyne's and Professor O'Connell's ability to steer and fund the goals, is what feeds the momentum and essentially puts equity to work.



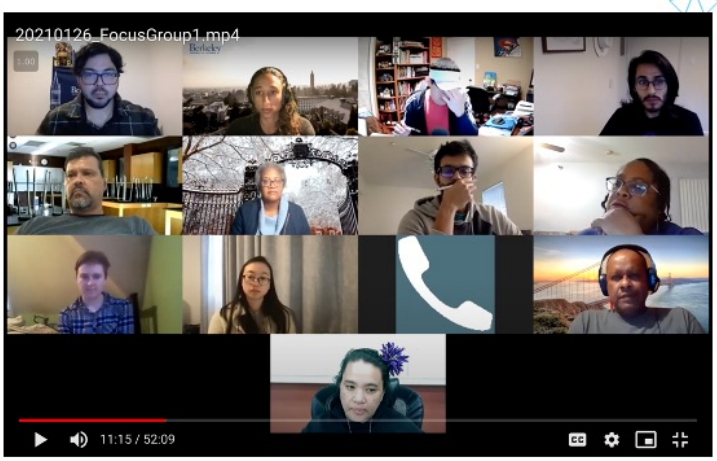
The approach we used for this project was taken from engineering design thinking coupled with human centered design. In engineering design thinking we want to first define the problem and brainstorm as many possible solutions before converging on a single solution (or two). In human centered design, we put the user in the center of our design and design for them. In this case the users or stakeholders can be considered as the high school students as well as the instructors. We need to design a kit that works within the space and constraints of the HS instructor and is interesting enough to engage a high school student.

Both of these design approaches have grown in popularity and importance within Mechanical Engineering curriculum at the undergraduate level at Berkeley. This is not necessarily a design approach that was taught to the graduate students on the project as they all did their undergraduate degrees at other institutions. So it provided an opportunity for the graduate students to learn Design Thinking and Human Centered Design by doing.

Focus Group

understanding the classroom

- 5 ME Graduate Students
- 6 HS Instructors
- 1 Former Principal



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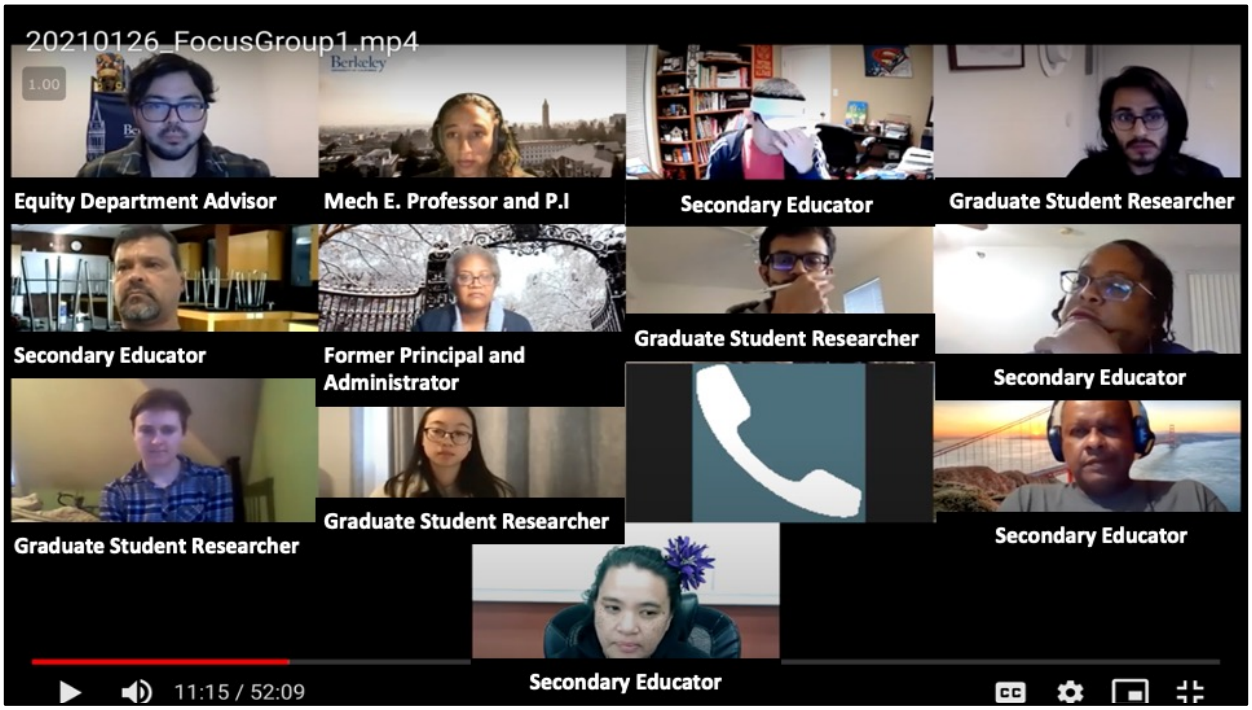
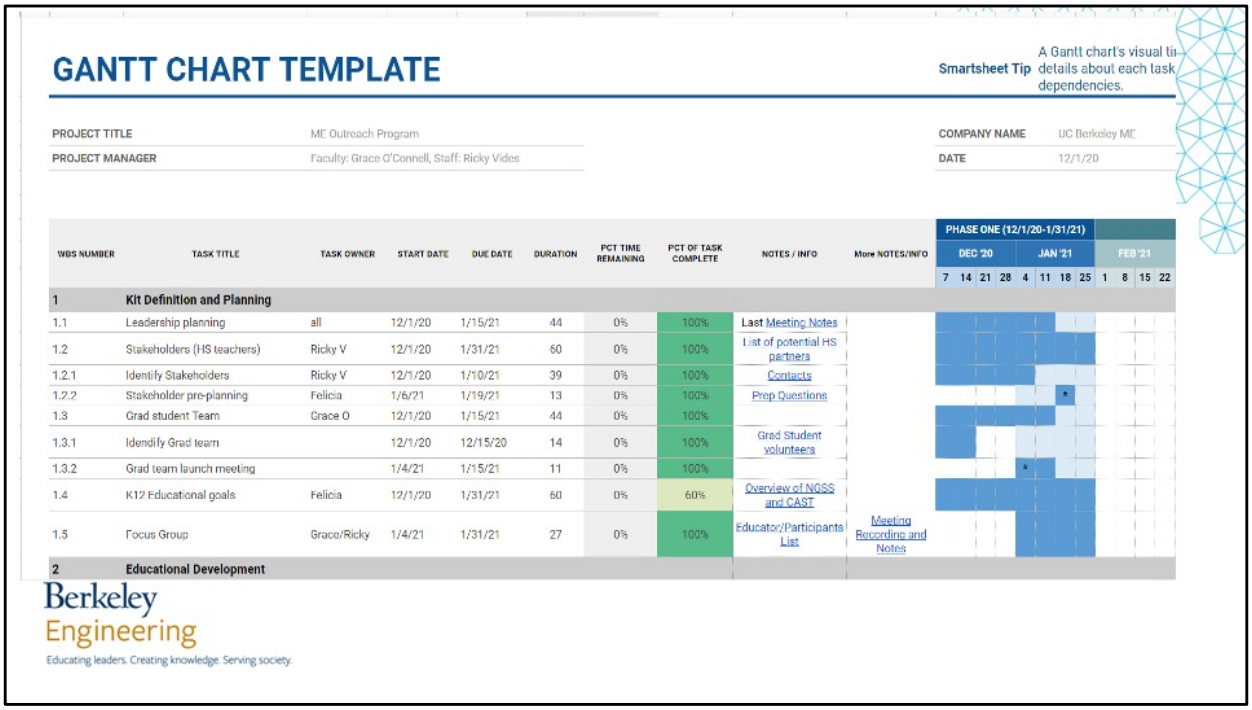
This picture was taken at our first focus group meeting with all stakeholders.



During this meeting we learned about differences in class size and classroom time. We also learned how much time the usually devote to a certain topic area and how long a hands on project could last before losing student interest and engagement.



GANTT CHART TEMPLATE

Smartsheet Tip: A Gantt chart's visual ti... details about each task ... dependencies.

PROJECT TITLE	ME Outreach Program	COMPANY NAME	UC Berkeley ME
PROJECT MANAGER	Faculty: Grace O'Connell, Staff: Ricky Vides	DATE	12/1/20

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION	PCT TIME REMAINING	PCT OF TASK COMPLETE	NOTES / INFO	More NOTES/INFO
1	**Kit Definition and Planning**								
1.1	Leadership planning	all	12/1/20	1/15/21	44	0%	100%	Last Meeting Notes	
1.2	Stakeholders (HS teachers)	Ricky V	12/1/20	1/31/21	60	0%	100%	List of potential HS partners	
1.2.1	Identify Stakeholders	Ricky V	12/1/20	1/10/21	39	0%	100%	Contacts	
1.2.2	Stakeholder pre-planning	Felicia	1/6/21	1/19/21	13	0%	100%	Prep Questions	
1.3	Grad student Team	Grace O	12/1/20	1/15/21	44	0%	100%		
1.3.1	Idendify Grad team		12/1/20	12/15/20	14	0%	100%	Grad Student volunteers	
1.3.2	Grad team launch meeting		1/4/21	1/15/21	11	0%	100%		
1.4	K12 Educational goals	Felicia	12/1/20	1/31/21	60	0%	60%	Overview of NGSS and CAST	
1.5	Focus Group	Grace/Ricky	1/4/21	1/31/21	27	0%	100%	Educator/Participants List	Meeting Recording and Notes
2	**Educational Development**								

PHASE ONE (12/1/20-1/31/21)

DEC '20: 7 14 21 28 | JAN '21: 4 11 18 25 | FEB '21: 1 8 15 22

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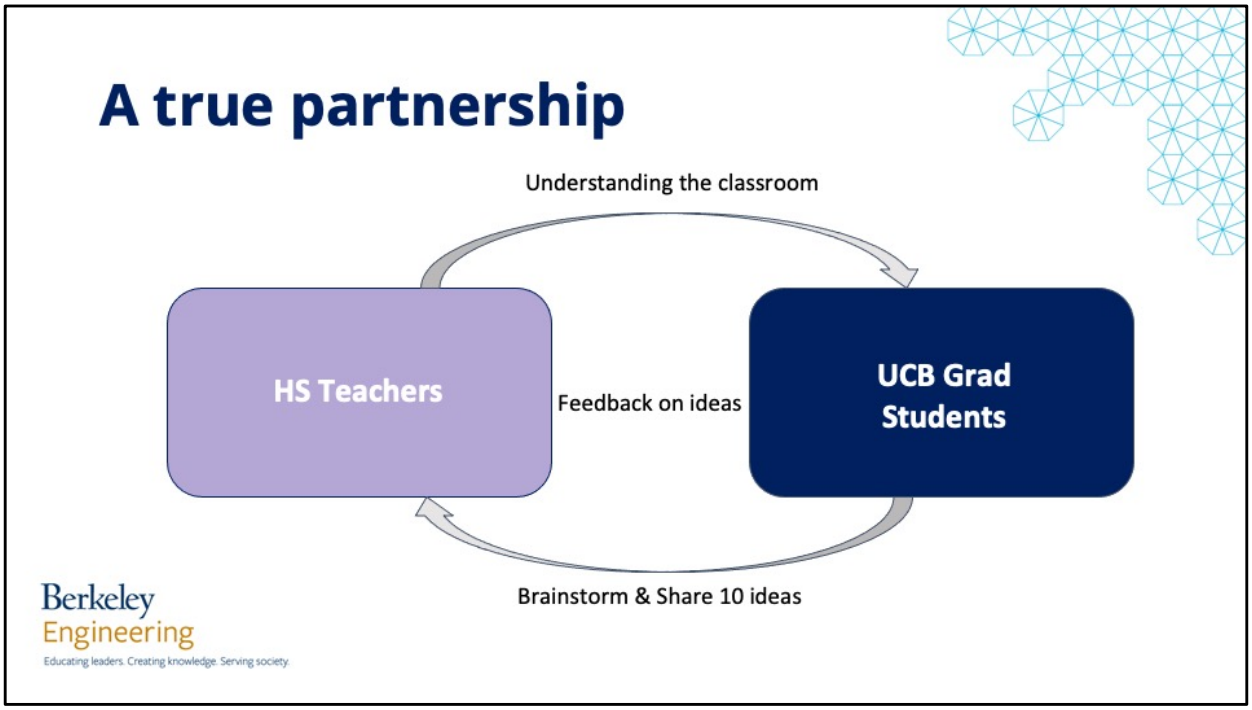
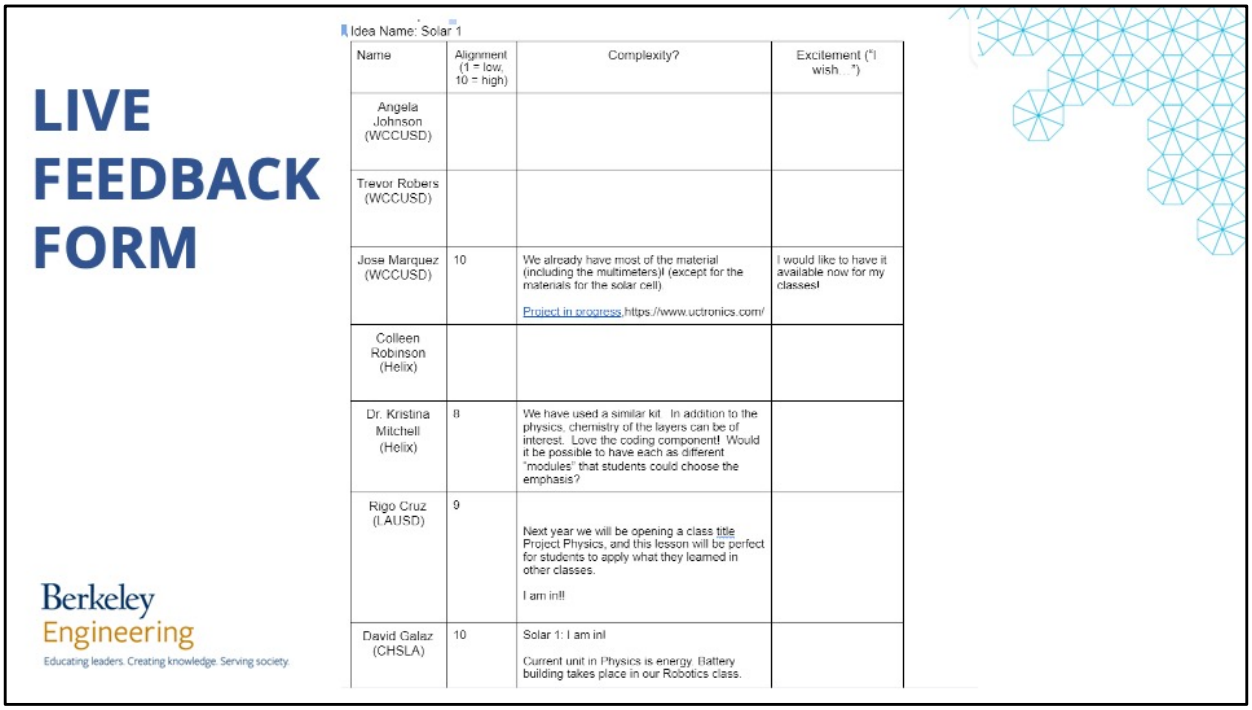
In order to keep track of so many moving parts in this project, Professor O'Connell developed a Gantt chart based on ideas shared during our strategy meeting. Our strategy meeting included a local secondary school expert, Felicia Phillips who is a STEM engineering alumna. The Gantt chart proved to be a great tool to archive the steps we're taking to keep the project running and it will eventually become a legacy document if we ever hand the project off. Thus far, it has been a good organizational tool for people to drop information about their progress and allows us to archive our recorded sessions. Specifically, the notes column has links to files, documents, and presentations, making it an easy one stop shop to gain information about the project and its progress.



To increase the likelihood of adoption of the hands-on kits in the classroom, we asked for feedback at critical times of the design process using the principles of Human Centered Design and Design Thinking.



LIVE FEEDBACK FORM

Idea Name: Solar 1

Name	Alignment (1 = low, 10 = high)	Complexity?	Excitement ("I wish…")
Angela Johnson (WCCUSD)			
Trevor Robers (WCCUSD)			
Jose Marquez (WCCUSD)	10	We already have most of the material (including the multimeters)I (except for the materials for the solar cell) Project in progress,https://www.uctronics.com/	I would like to have it available now for my classes!
Colleen Robinson (Helix)			
Dr. Kristina Mitchell (Helix)	8	We have used a similar kit. In addition to the physics, chemistry of the layers can be of interest. Love the coding component! Would it be possible to have each as different "modules" that students could choose the emphasis?	
Rigo Cruz (LAUSD)	9	Next year we will be opening a class title Project Physics, and this lesson will be perfect for students to apply what they learned in other classes. I am in!!	
David Galaz (CHSLA)	10	Solar 1: I am in! Current unit in Physics is energy. Battery building takes place in our Robotics class.	

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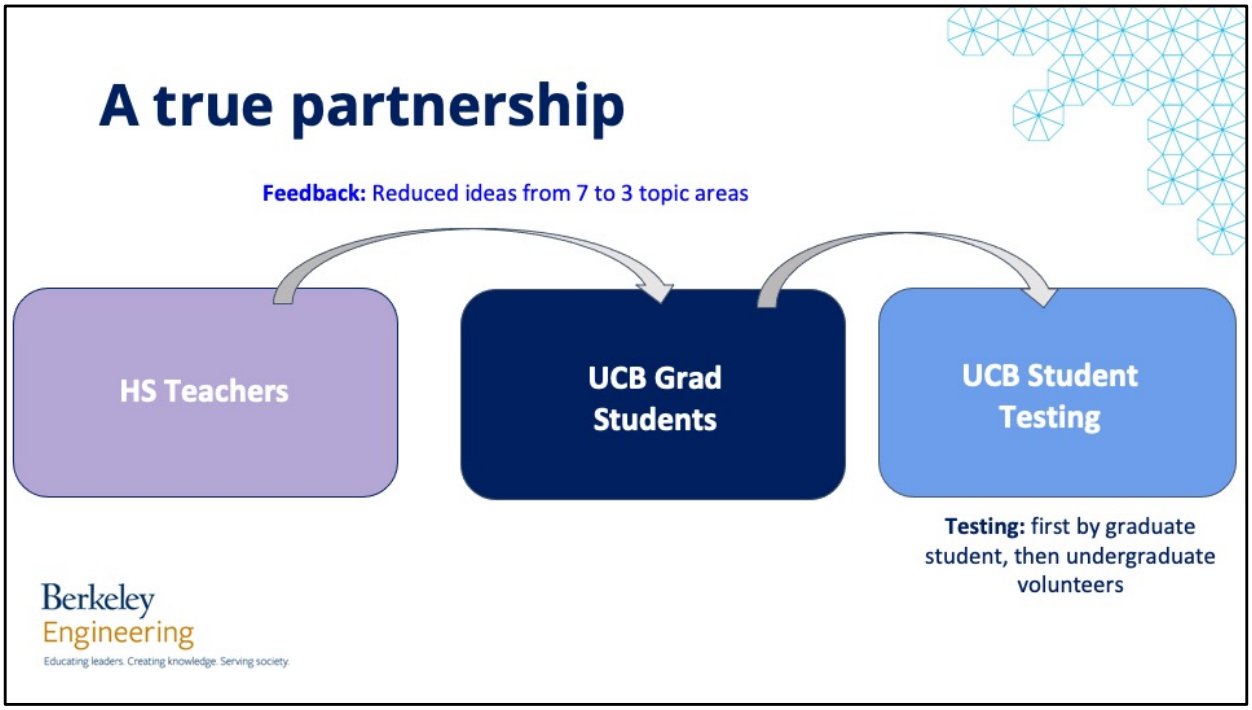
Another important tool utilized to encourage live discussion and guide partnership was the Live Feedback Form.

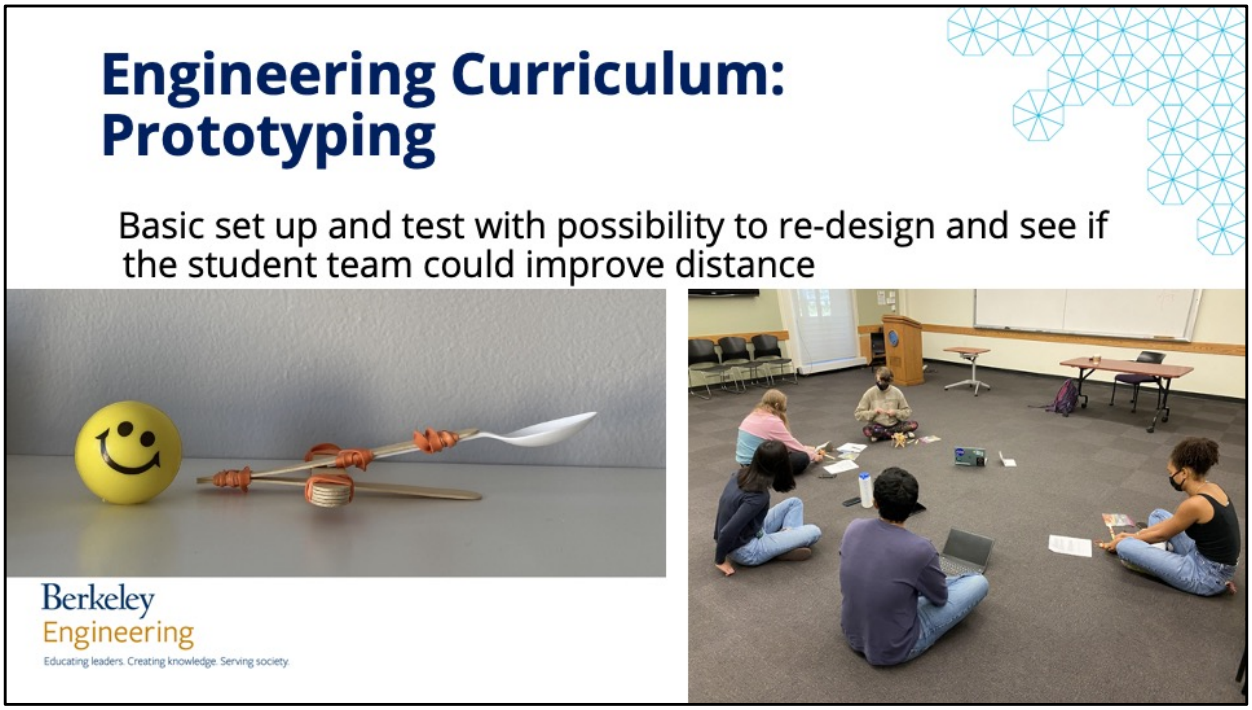
We used a google sheet to receive live feedback from high school instructors as the graduate students presented each of their ideas. We asked for a quick quantitative response, 1-10 scale with 10 being the highest for having a good fit in the classroom with regards to existing curriculum and expected student interest.

We also provided a space for instructors to provide written feedback on the perceived complexity of the individual project/kit and their excitement level.

From this feedback we learned that the project ideas that involved fluid mechanics were viewed as being too complex and further from the existing curriculum covered in their classroom.



To increase the likelihood of adoption we asked for feedback at critical times of the design process based on the principles of Human Centered Design. How HCD fits with current ME curriculum/faculty.



Paid undergraduates tested out the curriculum and gave us invaluable feedback about what they liked most and least about the curriculum. This process allowed us to anticipate what challenges may arise when trying to do this in a classroom. Some things were learned were issues around being able to accurately track the ping pong ball as it flies through the air. However, when we mentioned this to the high school instructors, one instructor shared that he was using freeware to do image processing that would work for measuring the height of the ping pong ball after launching.

Engineering Curriculum: Heat Transfer

- Last mile delivery of COVID-19 Vaccine
- Students to test different insulators and measure which one keeps ice from melting

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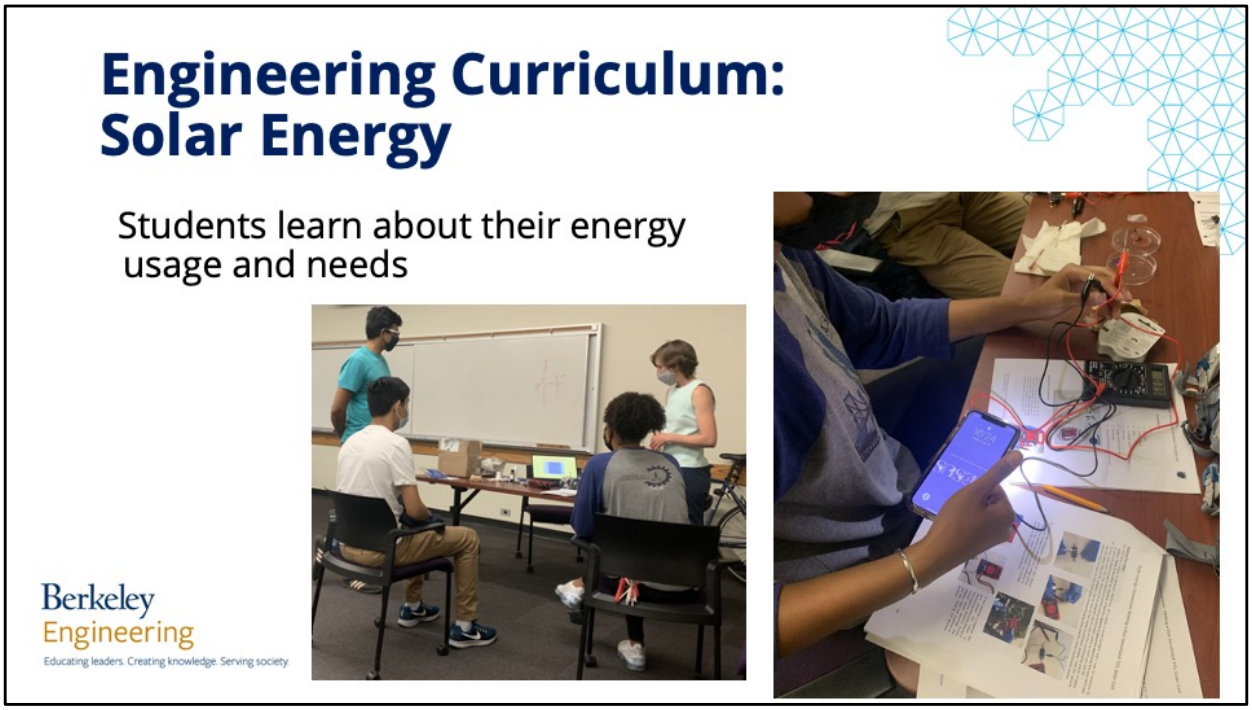
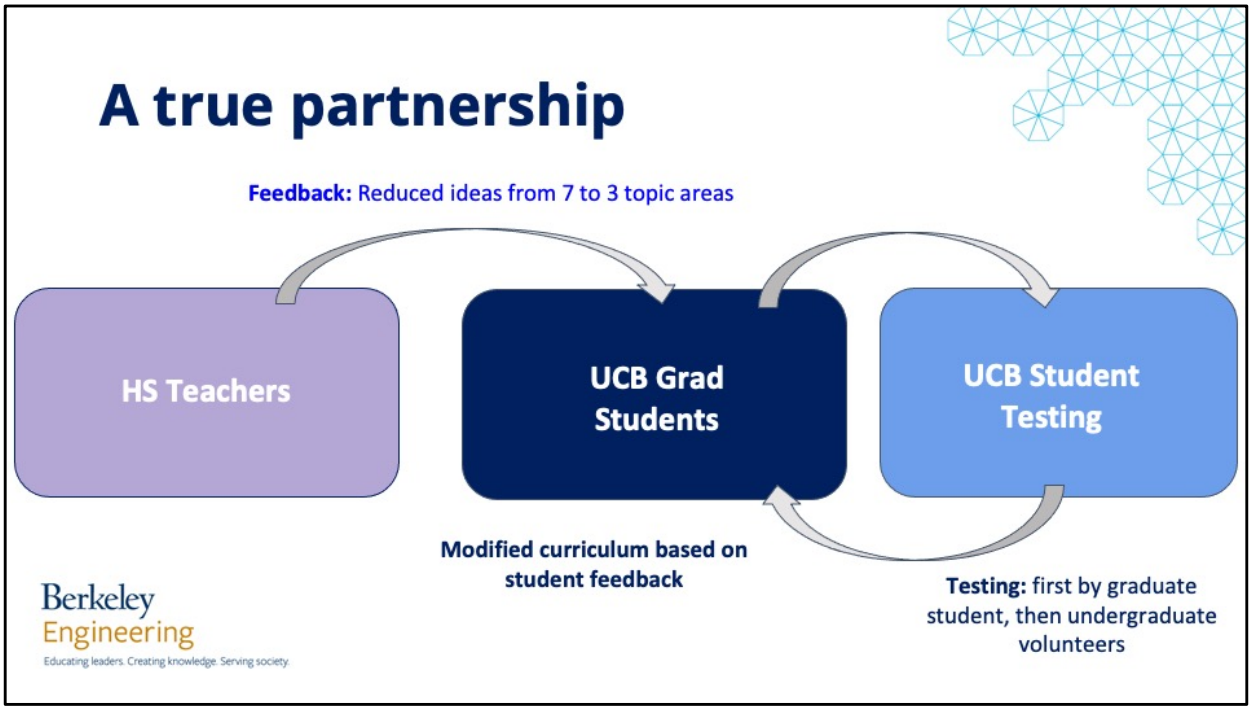
We also created a project that was meant to be a sign of our current times, a vaccine delivery kit. The purpose of this curriculum was to highlight how different materials can be used to maintain a certain temperature. In this case it is to keep ice frozen, which is important for shipping items at cooler temperatures -- like the COVID vaccine.

Based on the feedback, initial feedback from a high school student working with one of our high school instructors, we reduced the amount of ice used to decrease the time needed to be able to measure melted water. Based on the test run with the undergraduate students, we decided to modify the kit to include two materials for students to use and one material for insulation that they could bring from home. This way the curriculum could have two “known” conditions for the instructor to work from and students can test how well their intuition works for predicting good materials for insulation.



The solar energy curriculum was developed to teach students about energy usage and various sources for energy power, including renewable resources. Part of the curriculum includes an activity sheet so students can learn how much energy their household uses before exploring alternative energy approaches. The hands-on kit walks students through creating an organic solar cell, which is much lower in efficiency than a normal solar cell, but is able to work as a solar cell. In this kit, students use blackberries as the conductive material between two glass plates.

Based on the feedback from students, it was the most complicated activity. When we discussed this with the high school instructors they mentioned that it was an activity that they could reserve and test out with their more advanced science students or reserve as a follow up activity in the spring.



To increase the likelihood of adoption we asked for feedback at critical times of the design process based on the principles of Human Centered Design. How HCD fits with current ME curriculum/faculty.

K-12 Kits

- Great feedback from undergrads to modify curriculum worksheets
- Sent **360 kits to HS teachers** with one more virtual check-in

HS Teachers

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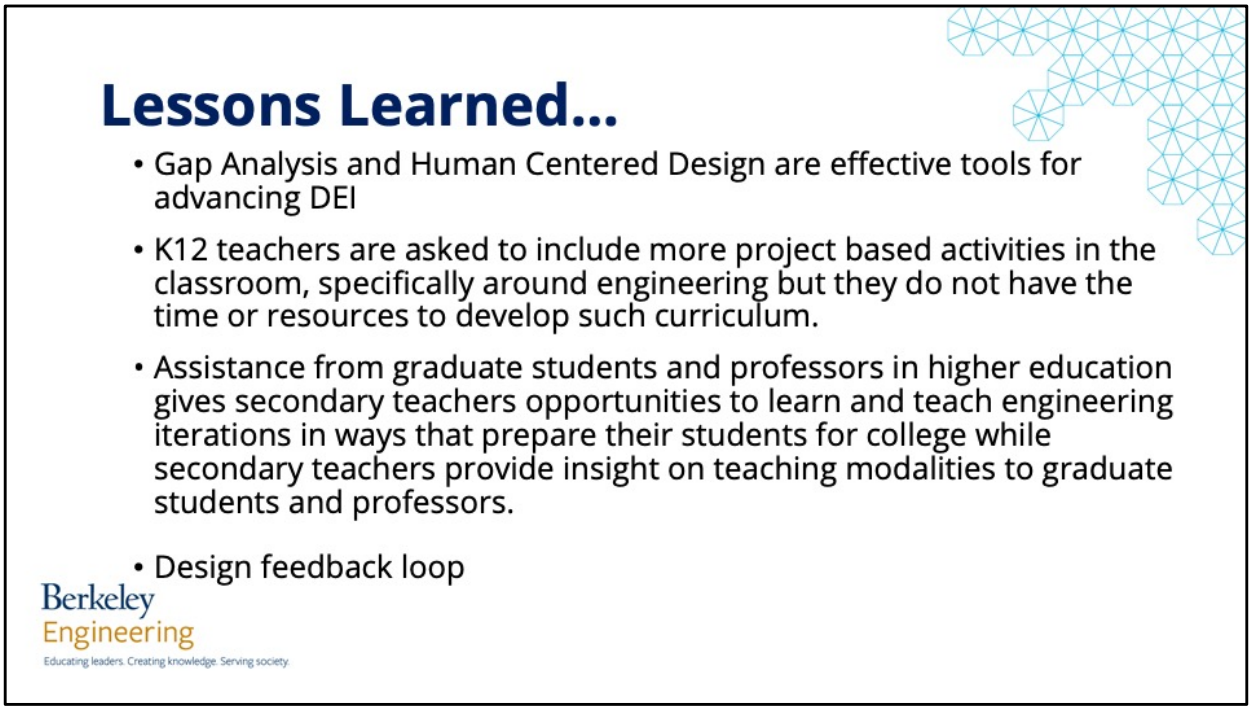
We leveraged this new information, acquired through our students who were test subjects, to modify the kits. One thing we did not anticipate was the challenges of assembling the kits and sending them to the instructors. This required additional human resources and we are pleased to say we successfully sent 360 kits to our 5 teachers to serve 30-35 students in each classroom.

Kits have been successfully shipped to our partner institutions and received by individual instructors to include within their usual curriculum as they see fit. At the end of the academic year we will touch base with the instructors after they use the three different kits with their students.



Some of the lessons learned from this project include: project management tools like gap analysis, the gantt chart, design thinking, and human centered design are engineering based tools described for product design or project management that are effective tools that can be used to strategically advance DEI efforts at a broader level beyond a single faculty member.

We learned a lot in this process about the demands on K12 teachers in terms of classroom curriculum and the challenges faced with limited resources -- like access to developed hands-on curriculum or materials.

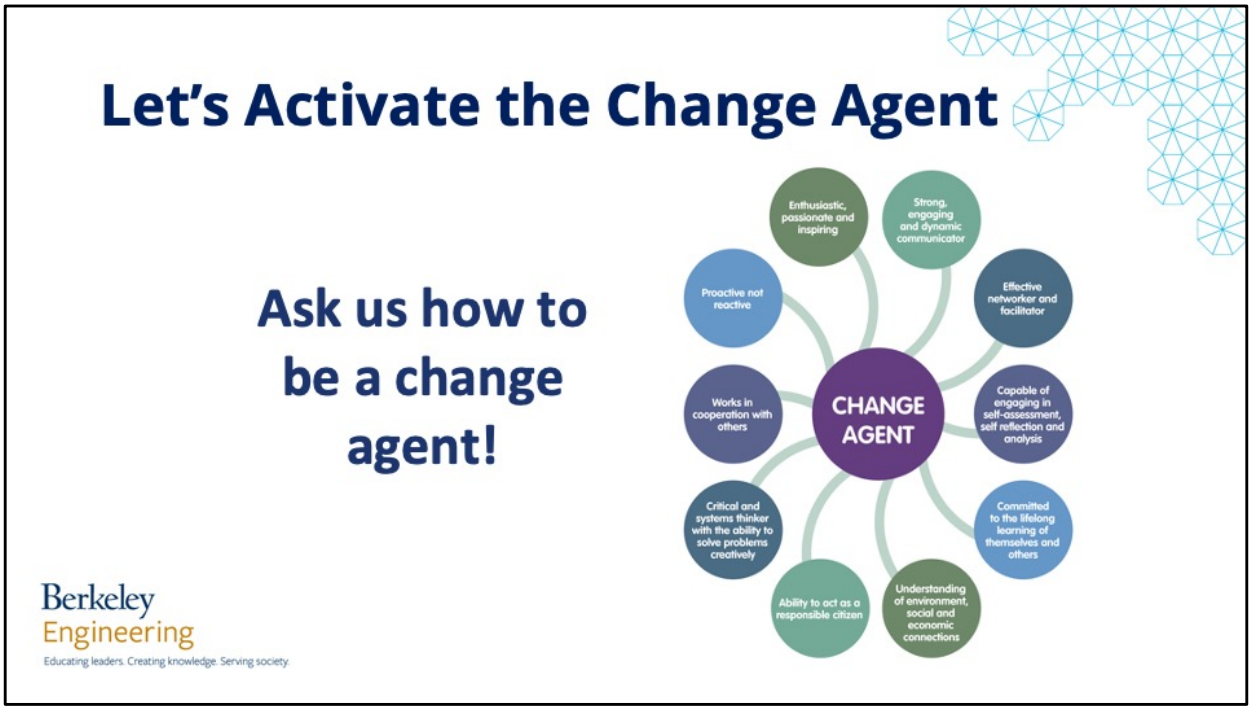
We also learned that assistance from graduate students and professors in higher education gives secondary teachers opportunities to learn and teach engineering iterations in ways that prepare their students for college while secondary teachers provide insight on teaching modalities to graduate students and professors.

Lastly, the design feedback loops provide extremely insightful information throughout the project. We believe that having teacher input throughout the project greatly improved the final “product” and we believe it will result in better outcomes in the classroom, which we plan to track and monitor over time with further

engagement with the instructors.

Such a large undertaking was certainly not possible by one individual faculty member and required lots of support throughout the college and local community.

Now we would like to take the time to acknowledge the support of our sponsors, collaborators, partners, and network. Thank you to our dean, former associate dean, the former ME department chair, ME's department manager, ME faculty and students, our secondary school expert, as well as our high school partners and their teachers: Richmond High School and Pinole Valley High School in West Contra Costa County, and in Southern California, Helix Charter High School, Franklin Senior High School and Cathedral College Preparatory High School.



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