

Section 1. Delineation of Social/Environmental Justice Issue

Humanity faces a plethora of complex social and environmental justice issues that have only been exacerbated by the current global pandemic. Around the world, we are seeing protests calling for reforms of healthcare systems, voting rights, systems perpetuating racial injustices, and climate action plans among many others. At the forefront of these movements have been the voices of youth who are taking action and demanding change to secure a brighter future for themselves and their loved ones. We understand that as youth enter the university space, they bring with them a variety of passions and motivations for pursuing a higher education which may cause them to gravitate towards specific social and environmental justice topics. Rather than selecting a single social or environmental justice issue that we as instructors are drawn to, we want to encourage students to collaborate around topics that ignite a fire within themselves through a project-based course.

We envision a course that follows the United Nations' 17 Goals for Sustainable Development (see Table 1, <https://sdgs.un.org/goals>) where students work in small interdisciplinary groups to collaborate on a project that addresses one of the goals that means the most to them. Through the variety of the 17 goals in combination with the adaptability of the instructors, we hope to attract students who are already passionate about specific worldly issues as well as students who are open to discovering new and meaningful development areas. In our course, students will begin by conducting broad background research on the sustainable development goal of their choosing which they will use to narrow their interests. Then, once the group has a firm foundation of the causes, effects, and hurdles within the area, they can decide on a specific issue that they can focus their research and problem-solving efforts on. Once the groups have conducted sufficient research and reached comfortable levels of knowledge on their specific topic within the time constraints of the course, we will support the students as they explore existing and possible solutions to their selected problem. Students may choose to conduct deeper research to understand current trends and solution efforts in their area, or students may choose to design and prototype their own solution. Throughout this course we, the instructors, will position ourselves as co-learners with our students as we explore how to research, collect expert opinions, and design solutions to solve the UN Goal they choose to focus on.

As an example of a group project within our proposed course, a group selecting *Goal 14: Life Below Water* would first research ocean sustainability, conservation efforts, and human actions that are negatively affecting ocean life to understand the scope and severity of the issues at hand. Then they would narrow their topic down to a specific problem area; examples include coral bleaching and efforts to reverse said phenomenon, overfishing in specific seas, or pollution caused by cruise ships releasing waste as they travel. To inform the design and development of a solution to their selected problem, students would conduct more targeted research on their specific topic including the causes, effects, potential solutions, and hurdles that need to be overcome. Additionally, we would encourage the group to reach out within their communities to inform user-centered design solutions by gathering opinions and feedback from ocean researchers at UCSB, industry leaders, local fishermen, or community members. Then as the culmination of their project the group would present their design solutions, emphasizing their reasoning for specific design choices.

Table 1.

The United Nations' 17 Goals for Sustainable Development

Goal	Description
1- No Poverty	End poverty in all its forms everywhere.
2- Zero Hunger	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3- Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages.
4- Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5- Gender Equality	Achieve gender equality and empower all women and girls
6- Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.
7- Affordable and Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all.
8- Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9- Industry and Innovation	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10- Reduced Inequalities	Reduce inequality within and among countries.
11- Sustainable Cities and Communities	Make cities and human settlements inclusive, safe, resilient and sustainable.
12- Responsible Consumption and Production	Ensure sustainable consumption and production patterns.
13- Climate Action	Take urgent action to combat climate change and its impacts.
14- Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15- Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt reverse land degradation and halt biodiversity loss.
16- Peace, Justice, and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17- Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Section 2. Fields of Knowledge to be Brought Together

Nate Tucker is a 4th-year PhD Candidate in the Electrical Engineering Department and focuses on solving impactful problems that lead humanity towards a more sustainable future. His research leverages recent advancements in mathematical optimization theory to improve the sustainability of large-scale societal systems such as the power grid and transportation networks. Recently, due to his work optimizing the recharging processes of fleets of electric vehicles, Nate was awarded with the UCSB's Institute for Energy Efficiency's (IEE) *Excellence in Research Fellowship* (given to 1 PhD student per year for cutting-edge research in the field of sustainability) for his contributions. Prior to his research at UCSB, Nate received his Master's degree from Santa Clara University (SCU) studying Electrical Engineering with emphasis in Renewable Energy and Sustainable Engineering. Throughout his Master's and PhD years, Nate has taught several courses (some inside his area of expertise and many outside) and was awarded the Outstanding TA Award at SCU due to his commitment and proficiency teaching students in both project-based and lecture-based courses.

In parallel to his research, Nate also has a strong passion for STEM education and mentoring younger students with research and solving impactful problems. Over the last 4 years, Nate has mentored several community college students through the PIPELINES (*Problem-based Initiatives for the Powerful Engagement and Learning In Naval Engineering and Science*) partnership program between UCSB and the Navy. In this program, Nate has guided pairs of community college students tasked with researching and presenting solutions for complex interdisciplinary engineering problems for the Navy. Additionally, over the last 2 years Nate has mentored several undergraduate interns on various sustainability focused projects related to his research which have led to publications in various conferences.

Ali Muller is a 3rd-year PhD Student who brings 13 years of experience in informal education settings where she worked with various institutions to increase STEM literacy, engage in citizen science efforts, and increase STEM self-efficacy. Her research centers around Research-Practice Partnerships (Penuel & Coburn, 2007) which positions members of the community as long-term collaborators in the production and use of research to create inclusive and equitable learning environments. Centered around the UN Sustainable Development Goal #4- Quality Education, her research has focused on the diversification of STEM fields through K-12 classroom and afterschool programs to support STEM identity development in pre-college youth. She has worked with programs such as The Curie-osity Project and University-Community(UC) Links to develop an understanding and framework for positioning youth as leaders in our communities. Her work in partnership with MOXI, The Wolf Museum of Exploration + Innovation has also looked at how to engage diverse communities in informal learning spaces that were historically inaccessible or unwelcoming to marginalized groups. She has also participated in interdisciplinary efforts to bring complex science topics to the general public through her work with EPIQC and the Quantum Foundry which both work towards a deeper understanding of quantum computing and materials respectively. In addition, Ali has experience working collaboratively with graduate students and post-doctoral candidates in STEM fields through her position as graduate student coordinator of the School for Scientific Thought and Apprentice Researchers. Within formal learning settings at the university, Ali also led project-based courses as a teaching assistant for ED124- Introduction to Leadership—a

project-based course designed to support undergraduates in making change in their local community.

Tucker and Muller have experience successfully developing courses together for high school students around complex topics that incorporate an element of social or environmental justice issues through their work together at the School for Scientific Thought (SST) within UCSB's Center for Science and Engineering Partnerships. Ali Muller has served as the graduate student coordinator for the program since 2018 and in Winter 2021, Nate Tucker joined as an instructor for SST to offer a course titled "The Global Energy Transition: From Fossil Fuels to Renewable Energy." We worked together to develop a 5-week virtual course for 10 high school students, 80% of which self-identified as an underrepresented minority, and 40% would be the first in their family to attend college. The course was designed to introduce students to renewable energy concepts, increase interest in pursuing an undergraduate degree, and support critical problem-solving in the face of the current energy crisis.

Section 3. How the Course Draws Upon Instructor Strengths

Coming from both STEM (Science, Technology, Engineering, and Math) and SHEF (Social Sciences, Humanities, Education, and Fine Arts) fields, we as instructors will be able to offer insight into the social and technical approaches one might take to solve the UN Sustainable Development Goals while also modeling interdisciplinary collaborative efforts. Both instructors have strong backgrounds in doing interdisciplinary work as well as experience in teaching and mentorship in project-based work. Our diverse backgrounds complement each other which will serve as a key cornerstone in supporting students by providing insight, direction, and advice as they explore their selected topics.

Ali Muller's background in STEM education will provide a strong foundation for incorporating best pedagogical practices into the course to encourage maximum engagement. In addition, her work is situated within science communication for the general public which will be helpful for students as they grapple with concepts that often get bogged down in technical jargon. Nate Tucker's experience serving as a mentor of diverse projects through the Pipelines program will be key in mentoring students as they develop their individual projects. His ability to provide constructive feedback on projects that he may not be positioned as an expert in will help us to create a collaborative learning environment within our course. As professional learners, we understand what it takes to explore topics unfamiliar to us, work with experts from diverse fields, and fail forward as we co-construct new knowledge. Together we will model productive interdisciplinary work for our students as we support and encourage them pursuing their passions.

Section 4. Why the Course will be of Interest to CCS Students

Unlike other university courses offered at UCSB that focus on the dissemination of knowledge to undergraduate students, our proposed course centers students as co-learners with the instructors as we work to understand and solve some of the largest problems facing our world (i.e., the UN's sustainable development goals). This course mirrors the structure of the CCS program at UCSB by encouraging students to pursue topics they are passionate about while the

instructors provide support, advice, and guidance. In alignment with the mission of the CCS program, our course provides passionate and talented students with a safe and supportive environment to hone their skills as co-creators of knowledge and active citizens in a global community. We position the plethora of knowledge, experiences, and passions that undergraduates bring to the university community as the main asset in the classroom environment, empowering students to guide their own learning journeys. By providing students with the opportunity to select a United Nations Sustainability Goal to focus their work on, we foster a connectedness to the greater global community that has come together to reach these goals while supporting the pursuit of individual passions. Project-based course work will allow students to select tasks that align with their personal and professional goals while simulating a real-world collaborative environment that they may encounter in their professional lives. In addition, students will have an opportunity to expand their professional networks as they work to collect expert opinions and understand community needs to develop their design solutions to their selected UN Goal. This course will complement student studies at UCSB while also preparing them to engage in complex problem solving in their future careers--a worthwhile addition to the undergraduate experience.