

Sustainable Design for Social Impact @ Oregon State University

Context

The dominant structure of higher education makes opportunities for multidisciplinary teamwork and innovation challenging, and does not provide opportunities to meaningfully incorporate sustainability throughout most students' academic programs. Yet feedback from employers and students indicates these skills are in high demand. In an effort to break down traditional disciplinary silos and prepare graduates who are passionate about and prepared for making positive change in society through multidisciplinary design, Oregon State University (OSU) is in the pilot stage of launching a new cross-cutting program called Engineering and Design for Society (EDS)¹. This initiative will offer undergraduates from across the university new options to learn design-centered skills through a multidisciplinary certificate in Design for Social Impact, and a new Bachelor of Science in Engineering degree in Engineering Design & Innovation. We are responding to an unmet need identified through co-design focus groups and interviews with students, constituents, and faculty, to create more specific skill building in interdisciplinary teams on tracks aligned with growing student and constituent interest in design thinking focused on sustainability, technology and the arts, entrepreneurship, and social change. Our team brings together expertise from engineering, business, graphic design, and education to create this content under the central hypothesis that the future of higher education lies in helping students to develop the skills at the right time, in the right place, and in the right format as they work on projects over which they have some choice and ownership. EDS is supported by the Provost through the OSU Impact Studio², hosted in its incubation and pilot phases by the Dean of the Honors College, sponsored by the Deans of Business, Engineering, and Liberal Arts, supported through \$230k in internal seed funding, and granted the as-yet unusual flexibility to work and explore new curricular directions across existing university and college boundaries and structures.

This proposal contributes to a long-term goal to re-engineer the university in a way that more fully meets the evolving needs and desires of a broad range of students. We will create opportunities for these and other OSU students to learn about innovation and sustainability in two formats: 1. a junior year course in Sustainable Design as part of an I&E studio-design spine for the planned BSE major and undergraduate certificate program; and 2. a variety of multidisciplinary modules that provide specific coverage of contemporary themes in sustainability in a range of inclusive formats and cost structures.

Proposed Initiative

Program Description

Our proposal is consistent with the mission of the EDS initiative at OSU (Appendix A) which has creative license to promote multidisciplinary education that breaks down the traditional silos that can exist between colleges, schools, and departments. The university

¹ See: <https://impactstudio.oregonstate.edu/engineering-and-design-society> .

² Impact Studio (see: <https://impactstudio.oregonstate.edu/>) is a dynamic venue coupled with best practice approaches for developing ways for Oregon State to respond creatively and nimbly to fast-changing trends in higher education.

Honors College (HC) is the pilot phase ‘host’ college for EDS, with the EDS Academic Director (Prof. J. Sweeney) reporting to HC Dean Toni Doolen (see LOS), and with additional sponsorship of our work by the Deans of Business (see LOS), Engineering, and Liberal Arts. The PI of this proposal (MacCarty), is a member of the EDS leadership team, and has brought together colleagues from education (Buxton), graphic design (Garcia), design & innovation management (Ruyle), engineering (DuPont), and entrepreneurship (Marie). This team will develop a menu of curricular and co-curricular modules, such as credit-bearing HC colloquia, special topics courses, and non-credit workshops/field trips, all designed to maximize student choice and equitable access.

Objectives

VentureWell funding will make it possible for us to develop these learning opportunities focused on innovation and sustainability via two channels, with a programmatic theme such as climate change, social impacts, or environmental justice each year:

1. A new course ENGR 3XX: Sustainable Design

The junior year of the new BSE degree program includes a project-based “design spine” sequence of courses on innovation for social good that spans three terms: 1. Design Thinking, 2. Sustainable Design, and 3. Capstone Visioning, each incorporating entrepreneurship and project management. This proposal will support the development of and supplies for the second course in this sequence: Sustainable Design. In this course, students will work in multidisciplinary teams to complete a design and manufacturing plan for an original, environmentally sustainable product or system. Combining theory in environmental impacts with integrated product design, students will be guided through an innovation-driven, user-centered design process that incorporates business, marketing, entrepreneurship, user studies, industrial design, and engineering design. Each of these skills are embedded at different points in the overall design process, and each is described through a specific sustainability lens, such as biomimicry, plastics recycling, cradle-to-cradle design, electricity generation, and others. This alignment is deliberate: students not only learn how to design products and systems, but their experience with the design process is clearly linked to the consideration of environmental sustainability at every step. Students will also apply multidisciplinary communication skills in product pitches and presentations to industry representatives, as well as technical writing and CAD/advanced sketching. Further, teams will be equipped and encouraged to move their product ideas toward patenting, joining our Launch Academy student business incubator, and/or applying for VentureWell E-teams.

2. A menu of sustainability and innovation modules

There is an unmet need for opportunities to develop specific skills and knowledge in sustainability in a just-in-time format. Students also crave the opportunity to work in multidisciplinary teams, but authentic opportunities for this are rare in the traditional siloed structure of the university. The modules we propose address both issues. To ensure equitable and diverse participation, we will intentionally build in maximum accessibility to students who may have constraints on their time and/or may not have room in their degree program for additional credit-bearing activities (e.g. student parents, working students, Pell eligible) by offering these modules in a variety of curricular and co-curricular modes, such as baccalaureate core courses, HC 1 credit hour colloquia, co-curricular field trips, and similar.

Working with OSU's Honors College and Ecampus programs to develop revenue structures based on existing systems, *the funds provided by VentureWell for personnel and materials/supplies will support the development and offering of modules such as:*

- **“Expanding the Sustainable Design Network”** field trip with pre and post work offered by Cory Buxton, Professor, College of Education. Buxton has an ongoing project to integrate design based and sustainability topics into middle school and high school science. This involves working directly with K-12 students in afterschool clubs and with families during family STEM workshops. This module will teach skills in communicating and disseminating ideas about sustainability and design with broader community audiences who may be unfamiliar with these ideas.
- **“Sustainable Business Practices”** weekly colloquia by Michelle Marie, Program Manager, InnovationX. Students will complete readings and discussions on topics such as employment practices, environmental externalities, and waste reduction strategies.
- **“Circular Design Approaches—from C2C to Circular Economy”** with multiple entry points offered by Shanna Ruyle, Instructor, College of Business. Students will solidify understanding of Circular frameworks, current conversations and design skills needed to contribute to a Circular Economy through several sub-modules:
 - **“Circularity: design systems that work with cycles”** a self-directed Ecampus module, will allow students to get familiar with Circular and cyclic-based design frameworks, such as Circular Economy, Cradle to Cradle, Biomimicry and The Natural Step. Knowledge-based learning to prepare for design application.
 - **“Circularity: extending the current conversation”** Conference/Webinar attendance and discussion forum (Ecampus or in-person) in which students will attend a live webinar or conference (e.g. GreenBiz Circularity21, Circular Economy World Economic Forum, Circular Economy Events from the Ellen MacArthur Foundation) discussing current considerations for business and design. They’ll use discussion and reflection to connect their current understanding with the new information and how it relates to their studies, community and future goals. Students will build their own point of view and be able to articulate the benefits and drawbacks of a Circular economy and/or design approach.
 - **“Skill-up in Circularity: applying design techniques”** Self-directed Ecampus module for knowledge and design cohort for application of specific techniques to increase a design’s ability to circulate or return responsibly to the biosphere, including Design for durability (physical, emotional, context), Design for sharing, Design for service (product/service flip)
- **“The Nature of Design and the Design of Nature—an outdoor adventure”** Saturday field trip offered by Shanna Ruyle, Instructor, College of Business. Students will learn directly from nature at the local William L. Finley National Wildlife Refuge. They’ll spend the first half of the day learning about key species on this 5,325 acre refuge with a “Challenge to Biology” design framework. Then flip the lens the other way in the second half of the day with a “Challenge to Design” Biomimicry framework. Students will build skills in identifying design inspiration from nature and how to apply the strategies to human design challenges. Based on the Biomimicry Institute Design Spiral framework.

- **“Regenerative Design: Making it Better”** Hack-a-thon weekend experience offered by Shanna Ruyle, Instructor, College of Business. Students will learn about and apply design frameworks that highlight the benefits of designing to heal and repair ecosystem and/or social systems. Through a design challenge (of their own choosing or identified in the community), students will create a design that they can directly see the benefits from in a local ecosystem, OSU Campus or surrounding community. Based on Permaculture, Design for Social Justice, Design Thinking/Human-Centered Design, Systems Thinking
- **“Sustainability in Sewn Product Design”** Field trip with pre-work offered by Michelle Marie, Program Manager, InnovationX. Students will do preliminary readings about sustainability in sewn product design (impacts on climate change, labor practices, environmental issues, waste reduction/reuse strategies). Then they will tour Portland-area sewn product industry locations (such as Portland Garment Factory, Nike, etc.) to learn about sustainability issues 'on location' and learn from experts.
- **“Turning OSU Trash into Treasure: Rethinking Waste Streams”** weekend experience with Dale McCauley, DAMlab Makerspace manager and COB instructor. Students will develop products from waste streams in the DAMlab Makerspace using OSU waste (such as retired athletics uniforms, electronics waste, etc). They will pitch their products at the end, focusing on the feasibility of continuing to produce the product.
- **“Everybody Entrepreneurs: Introduction to Sustainable Entrepreneurship”** weekly readings and discussion colloquia offered by Michelle Marie, Program Manager, InnovationX. Students will unpack cultural ideas of entrepreneurship and understand it as an approach, a skill set, an orientation to problem solving, and the ability to do things with ideas. Topics will include fundamentals of entrepreneurship and incorporate sustainability concepts such as labor practices, environmental issues, and waste reduction/reuse strategies.
- **“Exploring Design Thinking”**, offered by Andrea Marks, College of Business. Students will have the opportunity to explore, generate, and evaluate design problems and possible solutions through learning and applying the human-centered approach of design thinking.

Inclusive Recruitment

Our target audience is students who are attracted to the EDS focus on integrating principles of design, innovation, and sustainability towards social betterment. As an initiative that means to center innovation and design for sustainability, we must also bring this lens to our thinking about recruitment and retention of our participants (students, faculty, other partners). To ensure that our students reflect the diversity of the OSU student community, recruitment methods will be based in inclusive design practices. By designing programming to meet the needs of URM students, we will meet the needs of all students. We will use inclusive language in promotional material; for example, avoiding language that casts entrepreneurship in a high-risk, tech-heavy, masculine, wealthy, aggressive light in favor of language that defines entrepreneurship broadly as *doing things with ideas*. Because meeting URM students where they are is a crucial strategy for building programming that is inclusive of historically excluded students, we will work with student-facing campus partners on recruitment efforts. We will ask for support from units such as the Louis Stokes Alliance for Minority Participation (LSAMP) program, the Undergraduate Research, Scholarship, and Arts Engage (URSA Engage) program,

the Educational Opportunities Program (EOP), TRiO Student Support Services, Beyond Football, and the Distinguished Scholars Initiative to ensure that students across campus, particularly URM students, are aware of these opportunities.

Measuring Success

We aspire to build a robust, diverse community of creative, sustainability-minded students who are committed to the betterment of society. We will know we are successful when students participate in these new modules and courses, commit to pursuing the future EDS certificate and/or BSE degree, and refer their peers to participate. This will be quantified by number and diversity of students participating in the new courses/modules as measured by available, depersonalized course enrollment data and voluntary student surveys. Success will also be evaluated by student feedback via surveys and focus groups and the number of Launch Academy and E-teams created.

Opportunities to apply and disseminate ideas that have equity and social justice implications into communities beyond the university (a key focus of EDS) have been shown to support both recruitment and retention of underrepresented students in such programs. While universities have made strides in recent years in building recruitment strategies that center diversity, we have made less progress in integrating *retention* of URM students into initial design of programs³⁴. Therefore, the number of teams who grow their ideas beyond the classroom via Launch Academy student business incubator, or E-teams will be a crucial aspect of success.

Team and Partners

- **Nordica MacCarty**, Assoc. Prof. Mechanical Engineering, Richard & Gretchen Evans Scholar of Humanitarian Engineering, is a frequent E-team adviser and faculty grant holder also on the leadership team for EDS. Nordica will leverage VentureWell training to lead the project and develop the recruiting, administrative, and curricular/co-curricular structures.
- **Shanna Ruyle**, Instructor, Design and Innovation Management, College of Business, and Instructor for the OSU HC, holds a Masters in Sustainable Design. She develops and teaches sustainability concepts and frameworks for both the College of Business Design programs and the OSU HC. Shanna will manage sustainability module development and offering.
- **Michelle Marie**, Program Manager, InnovationX Center of Excellence for Innovation and Entrepreneurship and Advanced Launch Academy instructor and coach. Michelle holds a Master of Arts in Interdisciplinary Studies in Women Studies and Philosophy and a Ph.D. in Apparel Design and Human Environment. She will provide entrepreneurship modules, support recruitment efforts, and attend the VentureWell workshop.
- **Bryony DuPont**, Associate Professor of Mechanical Engineering and Boeing Professor of Engineering Design, will create the new BSE junior year sustainable design course.
- **Cory Buxton**, Professor of Science Education and expert in STEM education equity, will develop and teach one of the modules and also attend the VentureWell workshop.

³ Miriti, M. N. (2019). Nature in the eye of the beholder: A case study for cultural humility as a strategy to broaden participation in STEM. *Education Sciences*, 9(4), 291

⁴ Emery, C. R., Boatright, D., & Culbreath, K. (2018). Stat! An action plan for replacing the broken system of recruitment and retention of underrepresented minorities in medicine. *NAM Perspectives*.

- **Jim Sweeney**, Professor Emeritus of Bioengineering, as EDS Academic Director, will provide support for integration of project work into the overall EDS curricular framework.
- **Deann Garcia**, Instructor in Graphic Design, MA in Sustainable Design, will contribute to module offerings.
- **Andrea Marks**, Professor and Program Director, Design and Innovation Management in the College of Business at OSU, will contribute to module offerings.

Entrepreneurial Ecosystem

Oregon State University’s entrepreneurial ecosystem is robust. InnovationX, OSU’s Center of Excellence for Innovation and Entrepreneurship, offers co-curricular programming and the Launch Academy student business incubator each term to all OSU students. InnovationX will provide entrepreneurship support to this initiative via specific modules and with programming embedded within other modules and the ENGR 3XX sequence. The DAMlab Makerspace, a collaboration between the College of Business and the College of Engineering, will be available to EDS students in relevant modules. The DAMlab offers a comprehensive array of equipment, from sewing machines and soldering stations to CNC machines and 3D printers. Additional support for students who wish to develop specific projects is available through Launch Academy, the Advantage Accelerator, and/or the Lens of the Market –all well-established pathways to commercialization at OSU.

Work Plan

The gantt chart below shows the timeline for development and offering of the course and modules and administrative aspects of this effort. Estimated enrollments listed in cells are based on typical design studio course capacities and honors colloquia limits. These experiences will be conducted in teams of four, so if each team in each course or module will have the potential to apply for an E-team grant, *a high estimate would be generation of 60 E-teams*. It is also likely that modules created will be repeated in subsequent years, leading to an *underestimate* in module offerings and participation during the grant period presented here.

Objective	2022		2023			2024				Total
Establish administrative agreements	[Bar]									
Buxton and Marie attend Workshops										
Develop and Offer ENGR 3XX				30			30			60
Develop New Sustainability Module (one per color)	[Bar]	[Bar]	[Bar]	[Bar]	[Bar]	[Bar]	[Bar]	[Bar]	[Bar]	
Offer New Sustainability Module (one per color)	20	20	20	20	20	20	20	20	20	180

Outcomes:

In sum, the major outcomes of this effort will be the creation and offering of 1) a new ENGR 3XX course focusing on sustainable design; and 2) a slate of sustainable design modules within a variety of formats that can be adopted for other similar efforts within the EDS initiative and/or similar multidisciplinary initiatives at OSU (or elsewhere). Initial support from VentureWell will provide us with the buy-in and seed funds to develop a structure, incentive system, and budget model that will serve as ‘proof of concept’ to attract additional support. This initiative leverages and supports InnovationX resources, benefits from cross-disciplinary EDS innovation, and is likely to produce a significant number of E-teams.