Term Information

Effective Term	Spring 2025

General Information

Course Bulletin Listing/Subject Area	Environmental Engineering
Fiscal Unit/Academic Org	Civil, Envrnmntl & Geodtc Eng - D1427
College/Academic Group	Engineering
Level/Career	Undergraduate
Course Number/Catalog	3600
Course Title	Technology Innovation for Sustainability
Transcript Abbreviation	Tech Innov Sustain
Course Description	Society faces many challenges in terms of improving its environmental challenges. This course is designed to expose you to many of these challenges and the different technical and non-technical perspectives that will be necessary to understand and create solutions and a more sustainable future.
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture
Grade Roster Component	Laboratory
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	None
Exclusions	None
Electronically Enforced	Yes

Cross-Listings

Cross-Listings	

Subject/CIP Code

Subject/CIP Code	14.1401
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, Sophomore, Junior

Requirement/Elective Designation

Sustainability

Course Details

Course goals or learning objectives/outcomes

- Students will understand theories of sustainability that are commonly used in the engineering profession.
- Students will understand lean launchpad approaches to characterizing and describing business models and value propositions of technologies.
- Students will know how to calculate and evaluate sustainability metrics to evaluate interventions to improve the sustainability of engineered systems.
- Students will be able to perform, document, and interpret customer discovery interviews.
- Students will know how to use customer discovery tools to create and test business models and value propositions.

Content Topic List

- Humans, Technology, and the Environment
- Grand Challenges in Sustainability
- The Triple-Bottom Line & Life-Cycle Thinking
- Class Project Sustainability Challenge
- The Business Model Canvas (BMC) and the Value Proposition Diagram (VPD)
- Lean Launchpad and Hypothesis-Driven Testing
- Completing the VPD; Developing Hypotheses
- Developing Interview Protocols; Understanding the Business Ecosystem
- Customer Discovery Interviews (CDIs)
- Sustainability Metrics
- Carbon Footprinting
- Carbon Footprinting; Uncertainty Assessment
- Analyzing CDIs
- Analyzing CDIs
- From Idea-to-Market

Sought Concurrence   Yes

Attachments

- [EEOB] ENVENG 3600 Concurrence EEOB.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- [ENR] ENVENG 3600 Concurrence, Reviewed and approved by SENR AAC on march 6.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- [GEOG] concurrence.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- [Moritz] ENVENG 3600 Concurrence Email.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- [Public Health] ENVENG 3600 Concurrence.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- [SCBE] concurrence form.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- Concurrence email.pdf: Concurrence

  (Concurrence. Owner: Tolchin,Barry Scott)

- ENVENG 3600 R&CI Form.pdf: R&CI Form

  (Other Supporting Documentation. Owner: Tolchin,Barry Scott)

- ENVENG 3600 Revision Cover Letter.pdf: Cover Letter

  (Cover Letter. Owner: Tolchin,Barry Scott)

- ENVENG 3600 Sustainability Form.pdf: Sustainability Form

  (Other Supporting Documentation. Owner: Tolchin,Barry Scott)

- ENVENG 3600 Revision Cover Letter.pdf: Letter

  (Cover Letter. Owner: Tolchin,Barry Scott)

- ENVENG 3600 Syllabus.pdf: Syllabus

  (Syllabus. Owner: Tolchin,Barry Scott)

Comments

- Please see Subcommittee feedback email sent 01/16/2024. *(by Hilty,Michael on 01/16/2024 03:46 PM)*

- We know this is late for Spring 2024, so if it cannot be approved in time, we will offer in SP25. *(by Tolchin,Barry Scott on 09/05/2023 10:29 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Tolchin,Barry Scott	09/08/2023 01:12 PM	Submitted for Approval
Revision Requested	Tolchin,Barry Scott	09/10/2023 01:18 PM	Unit Approval
Submitted	Tolchin,Barry Scott	09/10/2023 01:19 PM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	09/26/2023 03:06 PM	Unit Approval
Approved	Quinzon-Bonello,Rosario	09/26/2023 03:06 PM	College Approval
Revision Requested	Hilty,Michael	11/03/2023 04:33 PM	ASCCAO Approval
Submitted	Tolchin,Barry Scott	11/22/2023 09:09 AM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	11/27/2023 05:31 PM	Unit Approval
Approved	Quinzon-Bonello,Rosario	11/27/2023 05:31 PM	College Approval
Revision Requested	Hilty,Michael	01/16/2024 03:46 PM	ASCCAO Approval
Submitted	Tolchin,Barry Scott	01/19/2024 10:03 AM	Submitted for Approval
Approved	Quinzon-Bonello,Rosario	01/23/2024 10:51 AM	Unit Approval
Approved	Quinzon-Bonello,Rosario	01/23/2024 10:51 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	01/23/2024 10:51 AM	ASCCAO Approval

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Dear colleagues,

This letter and revised submission package is to provide further detail on ENVENG 3600 Technology Innovation for Sustainability. This letter is to highlight changes made in response to feedback provided by the relevant subcommittees based on their meetings in October 2023 and to provide additional detail on the research and creative inquiry methods used in this class.

In response to comments from the GEN Theme: Sustainability, I have greatly expanded the detail provided in the syllabus – including a day-by-day breakdown of topics and readings. This detail on sustainability can be seen in weeks 1-4, which provides the foundation of understanding the natural world and its interactions with the technosphere created by humans to support human well-being, and in weeks 10-12, which provide students a foundation in quantitative sustainability assessment using life-cycle assessment metrics. However, as can be seen in the syllabus, some days in the first third of the course are marked "Course Project Topic Lecture" with limited detail provided about them. These days are an acknowledgement of the fact that the course project will vary from semester-to-semester to reflect changes in the on-going research by the instructor related to understanding the role of emerging technology in addressing sustainability challenges. This flexibility is essential to create a course that will allow us to tailor projects that give students an the instructional team the flexibility to be responsive to the needs of the Ohio State and Columbus communities. This is especially relevant given the expectation that research & creative inquiry classes provide students with "opportunities to discover relevance of learning through real-world applications" that are connected to a larger conceptual framework. However, given the needs of the subcommittee to evaluate those lectures as providing evidence of a deep study of sustainability, I have provided a copy of the schedule for a *Group Studies* course being offered by our Department to pilot this course. This offering has a project on the topic of flexible building energy use and the "Course Project Topic Lecture" days are on the topics of energy use in buildings and energy decarbonization. These days are highlighted in the schedule provided in the following pages of the cover letter.

In response to comments from the Research & Creative Inquiry subcommittee, I have provided additional detail in the syllabus as to how scaffolding of developing research methods is being approached in this class. To that end, I have been working with our advising team to understand potential schedules for this course. The revised syllabus reflects our current plan of a 55-minute session four times a week. The general structure of a week is that Monday and Wednesdays are lecture days, with a research or teamwork skill being introduced, practiced, or iterated on throughout the semester on Tuesday and Thursdays. These plans for Tuesdays and Thursdays also include numerous opportunities to present to the class for feedback from the instructor and from classmates (with training on how to provide feedback provided to the students in Week 2). These opportunities to iterate and present on their findings are easier to see in the revised syllabus with the full schedule and in a separate page at the end of the document that provides more detail on how the course meets the expectations for R&CI high-impact courses.

In addition, I believe it may be helpful to provide the R&CI subcommittee with more details on the research methodology that students will be introduced to - *the lean launchpad*. Core to the idea of the lean launchpad is that there are "no facts inside the building". Instead, an inventor only has hypotheses about what customer pains are and how their proposed solution addresses those pains. As a result, innovators must "get outside their building" to test their hypotheses and revise their business model based on what they learn about their customers. In this class, this process involves the following activities:

- Developing *hypotheses* about customer needs and aspects of the business financial model. Using the framework of the business model canvas, students will develop falsifiable hypotheses about nine aspects of a business model: (1) customer segments, (2) value propositions, (3) channels, (4) customer relationships, (5) revenue streams, (6) key resources, (7) key activities, (8) key partnerships, and (9) cost structures.
- Designing and prioritizing *experiments* to try to falsify these hypotheses. The design of these experiments includes specifying metrics to judge success, the participants (e.g., potential customers) to be included in the experimental design, and the plan to conduct these experiments. In this class, students will design at least two experiments – a customer discovery interview and another type (e.g., observing customer interest in a solution by via pre-orders or advertising).
- Conducting experiments to falsify these hypotheses. Students will gain in-depth familiarity with how to conduct the most commonly used experiment in this space, *customer discovery interviews*, and then actually conduct 10-15 customer discovery interviews. While not an exact parallel, these interviews are similar to other qualitative research methods, including key informant interviews.
- Analyzing experiment results to synthesize findings and then *iterate* on a business model, by refining or rejecting hypotheses and then proposing new ones to be studied in the next round of experiments.

The revised syllabus includes the assigned readings for each of these steps – readings which come from the key books used in practice. This method is not only used within industry by startups seeking to better understand their markets but is also core to the training provided by the U.S. Federal Government for the nation's scientific and technical workforce. This is done through the I-Corps programs run by the National Science Foundation and National Institutes of Health (for scientists that receive funding from them) or for those in the Department of Energy's National Lab system. This course is inspired by these trainings (as I was part of a team for the Department of Energy's I-Corps program) and I am excited to bring these methods to our students.

Finally, as requested I have updated the language in the syllabus around supporting students. Thank you for considering this request. Please do not hesitate to let me know if you need additional information.

Sincerely,

Daniel B. Gingerich
Assistant Professor
Department of Civil, Environmental and Geodetic Engineering
Department of Integrated Systems Engineering
College of Engineering

Course Schedule

Week	Day	Topic	Reading(s)*	Course ELOs
1	Mon	Defining Sustainability	EESD pp. 28-33, 38-51	A.1, A.2
	Tue	Skill Session: Estimating	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 2. Quantitative and Qualitative Methods Supporting Life-Cycle Assessment	A.4
	Wed	Sustainable Development & Growth	EESD pp. 8-20	A.1, A.2
	Thu	Skill Session: Group Dynamics & Contracts	Last, S. Technical Writing Essentials – Chapter 4. Teamwork and Communication	
2	Mon	*NO CLASS – MLK JR. Day*		
	Tue	Group Work Time: Establishing a Group Contract	No Reading	
	Wed	Challenging Resource Limits: Finding Sources & Efficiencies	EESD pp. 296-319	A.1
	Thu	Skill Session: Providing Feedback	No Reading	
3	Mon[a]	Life-Cycle Thinking	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 1. Life Cycles and Systems Thinking	A.3, A.4, D.1
	Tue	Skill Session: Developing a Product Life Cycle	No Reading	D.1, D.2
	Wed[b]	Decarbonizing Energy	EESD pp. 696-711, 758-780	A.1, A.2
	Thu	Lab Activity: Room Energy Audit		A.1, A.2
4	Mon[a]	Decarbonization Strategies: Conservation, Low- and No-Carbon Fuels, Electrification	EESD pp. 781-810	A.1, A.2
	Tue	Skill Session: Technical Writing – Memos	Wahlin, L. Fundamentals of Engineering Program Technical Communications – Chapter 5. Writing Common Technical Documents	E.3
	Wed	Energy for Buildings	EESD pp. 1008-1015	A.1, A.2
	Thu	Revise COURSE PROJECT TOPIC LAB Memo Workshop	No Reading	E.3
5	Mon[a]	Business Model Canvas	BMG pp. 14-44	B.1
	Tue	Skill Session: Ideation	BMG pp. 125-145	B.1, B.2, C.1
	Wed[b]	Value-Proposition Diagram	Osterwalder, A. *et al.* Value Proposition Design – Chapter 1. Canvas	B.2
	Thu	Group Work Time: Ideating a Solution	No Reading	B.1, B.2, C.1
6	Mon[a]	The Lean Launchpad Cycle	BMG pp. 244-261	B.1, B.2, C.1

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	Tue	Skill Session: Story Telling	BMG pp. 171-179	
	Wed	Experiment Design	Testing pp. 29-52	C.2
	Thu	Group Idea Pitch Presentations	No Reading	C.1
7	Mon[a]	Empathy & Design	EESD pp. 862-867	B.2
	Tue	Group Work Time: Revise Pitches	No Reading	B.1, B.2, C.2
	Wed	Hypotheses for Business Models	Quine, W.V. and Ullian, J.S. *Hypothesis* in Introductory Readings in the Philosophy of Science	C.1
	Thu	Skill Session: Developing Hypotheses and Experiments	Testing pp. 53-58	C.1, C.2
8	Mon[a]	Business Ecosystems	BMG pp. 200-211	B.1
	Tue	Hypotheses and Experiments Presentations	No Reading	C.1, C.2
	Wed[b]	Customer Discovery Interviews	Talking pp. 31-43	E.1, E.2
	Thu	Group Work Time: Iterate on Hypotheses and Business Model	No Reading	B.1, B.2, C.1, C.2,
9	Mon[a]	Developing Customer Interview Questions	Talking pp. 44-58	C.2, E.1, E.2
	Tue	Draft Business Model Presentations – Set 1	No Reading	B.1, B.2, C.1, C.2
	Wed	Other Forms of Experiments	Testing pp. 69-60	C.1
	Thu	Draft Business Model Presentations – Set 2	No Reading	B.1, B.2, C.1, C.2
10	Mon[a]	The Sustainability Triangle	EESD pp. 820-830	A.3
	Tue	Group Work Time: Iterate on Business Models & Value Propositions	No Reading	B.1, B.2, C.1, C.2
	Wed[b]	Revenue & Cost Estimations	Matthews H.S., *et al.* Life Cycle Assessment – Chapter 3. Life Cycle Cost Analysis	A.3, A.4
	Thu	Group Work Time: Iterate on Business Models & Value-Propositions	No Reading	B.1, B.2, C.1, C.2
11	Mon[a]	Environmental Life-Cycle Assessment	EESD pp. 894-904	A.3, A.4, D.1
	Tue	Skill Session: Presenting Data	Wahlin, L. Fundamentals of Engineering Program Technical Communications – Chapter 4. Using Graphics and Visuals Effectively	E.3
	Wed	Estimating Product Carbon Emissions	EESD pp. 781-791	D.2, D.3
	Thu	Skill Session: Poster Design	No Readings	E.3
12	Mon[a]	Estimating Climate Impacts	EESD pp. 904-928	D.2

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	Tue	Group Work Time: Carbon Reduction Infographic	No Readings	D.2, D.3
	Wed[b]	Modeling Uncertainty in Climate & Cost	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 2. Quantitative and Qualitative Methods Supporting Life-Cycle Assessment	D.2, D.3
	Thu	Carbon Reduction Infographic Presentation	No Readings	D.2, D.3
13	Mon[a]	Interpreting Interviews	Talking pp. 59-65 Testing pp. 59-67	C.3, E.4, E.5
	Tue	Group Work Time: Revise Business Model Canvas	No Readings	C.3, E.4, E.5
	Wed[b]	Segmenting the Market	Video – "How to Niche your Customer Segments: Finding your Early Adopters"	E.4, E.5
	Thu	Group Work Time: Revise Business Models Canvas	No Readings	C.3, E.4, E.5
14	Mon[a]	Customer Validation: Get, Keep, Grow Strategies	Videos – "Get Keep Grow" series from Steve Blank's *How to Build a Startup*	B.3
	Tue	Final Business Model Poster Presentations – Set 1	No Readings	B.1, B.2, C.3, E.4
	Wed	Customer Validation: Market Positioning	Article - "Market Positioning: 5 Types of Market Positioning Strategies"	C.3, E.4, E.5
	Thu	Final Business Model Poster Presentations – Set 2	No Readings	B.1, B.2, C.3, E.4
15	Mon[b]	Technology for a Sustainable Future	EESD pp. 1024-1051	A.1

In the day column, the superscript indicates the following:
   a: Quiz
   b: Reflection Due
In the readings columns, the textbooks are shortened as follows:
- "EESD" refers to *Environmental Engineering and Sustainable Design (2nd ed.)* by Striebig *et al.*
- "BMG" refers to *Business Model Generation* by Osterwalder & Pigneur
- "Talking" refers to *Talking to Humans* by Constable and Rimalovski
- "Testing" refers to *Testing with Humans* by Constable and Rimalovski

More details on course textbooks can be found below. Selections for other readings will be posted to Carmen.

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Technology Innovation for Sustainability
ENVENG 3600

Course Information

- **Mode of delivery:** In-Person
- **Course times:** M-R 9:10am - 10:05am
- **Course location:** TBD
- **Credit hours:** 4 credit hours

Instructor

- **Name:** Daniel B. Gingerich, Ph.D. (he/him/his)
- **Email:** gingerich.62@osu.edu
- **Office hours:** TBD
- **Preferred means of communication:**
  - My preferred method of communication for questions is **email.**
  - My class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to be sure you receive these messages.

Course Prerequisites

There are no pre-requisites for this course.

Catalog Description

Application of quantitative sustainability assessment and innovation to create, ideate, and evaluate technological solutions to grand sustainability challenges facing society.

Course Description

Society faces many challenges in terms of improving its environmental challenges. From meeting the energy, food, and water needs of a growing (and developing) global population; to building communities that are resilient and healthy; and combatting and adapting to climate change, engineers, architects and planners will play crucial roles in solving the pressing sustainability challenges. This course is designed to expose you to many of these challenges and different technical and non-technical perspectives that will be necessary to understand and create solutions and a more sustainable future. But to truly solve these challenges, engineers, architects, and planners will not be able to deploy solutions from above and hope they make a difference. Instead, technologists will need to work closely with potential stakeholders to understand their needs and use cases. To that end, this course will expose you to concepts from the *Lean Launchpad* methodology to help you understand how the market for sustainable technologies and to evaluate the environmental and economic impact of potential innovations using a variety of *quantitative life-cycle methods* to assess sustainability.

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Learning Outcomes

This course has five course goals and associated learning outcomes (as laid out below). In addition, these course goals and learning outcomes are closely aligned with the requirements for the sustainability general education theme and to be consistent with high-impact practices for research & creative inquiry as detailed on pages 3-5.

Goal A – Students will understand theories of sustainability that are commonly used in the engineering profession.

Learning Outcome 1 – Students will be able to discuss sustainability and environmental challenges facing society.
Learning Outcome 2 – Students will be able to identify features of sustainability approaches and theories from outside of engineering.
Learning Outcome 3 – Students will be able to distinguish between the three bottom lines in the triple bottom line approach to sustainability.
Learning Outcome 4 – Students will be able to describe methods used to quantify different bottom lines.

Goal B – Students will understand lean launchpad approaches to characterizing and describing business models and value propositions of technologies.

Learning Outcome 1 – Students will be able to describe the individual components of the business model canvas.
Learning Outcome 2 – Students will be able to describe the individual components of the value proposition canvas.
Learning Outcome 3 – Students will be able to describe the aspects of get-grow strategies.

Goal C – Students will know how to use customer discovery tools to create and test business models and value propositions.

Learning Outcome 1 – Students will be able to develop testable hypotheses about the value propositions and business model for a technology for a customer and others in the business ecosystem.
Learning Outcome 2 – Students will be able to develop customer discovery interview protocols that allow them to test hypotheses about the value proposition and business model.
Learning Outcome 3 – Students will be able to evaluate learnings from customer discovery interviews and how they support fail to support hypotheses about the customer.

Goal D – Students will know how to calculate and evaluate sustainability metrics to evaluate interventions to improve the sustainability of engineered systems.

Learning Outcome 1 – Students will be able to develop life-cycle diagrams for common consumer products and goods from cradle-to-grave.
Learning Outcome 2 – Students will be able to find data from public databases and other reputable sources for use in sustainability assessment.
Learning Outcome 3 – Students will be able to calculate the carbon footprint of a product.

Goal E – Students will be able to perform, document, and interpret customer discovery interviews.

Learning Outcome 1 – Students will be able to appropriately reach out to potential interview participants to schedule interviews.
Learning Outcome 2 – Students will be able to ask appropriate follow-up questions to better understand customer/stakeholder perspectives
Learning Outcome 3 – Students will be able to create documentation of customer discovery interviews that note questions asked and responses from interview participants

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Learning Outcome 4 – Students will be able to develop a representative value proposition diagram for a group of stakeholders/customers.

Learning Outcome 5 – Students will be able to identify similarities and differences in the value proposition diagrams developed for different stakeholder groups.

Sustainability Education General Theme

This course has been designed to align with the requirements of the Sustainability GE Theme and focuses (although not exclusively) on the "Engineering, Technology & Design" and "Business, Economy & Governance" themes in the Ohio State model of sustainability. Throughout the semester you will engage in lectures, readings, quizzes, guided reflections, and a semester-long project that are designed to challenge you to think deeply and study a sustainability challenge in-depth. The GE Theme ELOs and the corresponding course ELOs, weeks where covered, and assessment activities are:

Goal 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than in the Foundations component.

Sustainability ELO	Course ELO	Weeks	Assessment Activities
1.1 *Engage in critical and logical thinking about the topic or idea of the theme.*	A.1-A.4, D.1-D.3	1-15	Reflections, Quizzes, Solution Proposal
1.2 *Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme.*	A.1-A.4, D.1-D.3	1-4, 10-12	Reflections, Quizzes, Solution Proposal

In lectures and readings, you will be exposed to the concepts necessary to engage in critical thinking about technical solutions to sustainability (1.1), environmental science and engineering concepts to understand environmental mechanisms (1.1, 1.2), and life-cycle thinking (1.2). During the semester-long project, you will also critically think about ideas for solutions (1.1), what you hear from people during customer discovery interviews (1.1), and tying proposed solutions to underlying environmental mechanisms (1.2).

Goal 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to wok they have done in previous classes and that they anticipated doing in future.

Sustainability ELO	Course ELO	Weeks	Assessment Activities
2.1 *Identify, describe, and synthesize approaches or experiences as they apply to the theme.*	B.1, B.4, E.4-E.5	2, 4, 10	Reflections, Solution Proposal
2.2 *Demonstrate a developing sense of self a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.*	B.3, C.1-C.3, E.1-E.5	9, 13-15	Reflections, Revised VPD, Final Project Deliverable

In lectures and readings, you will be exposed to the grand challenges (2.2), an in-depth environmental problem related to one of the grand challenges (2.1, 2.2), and metrics that can be used to measure the impacts of process improvements to address these challenges (2.2). During the semester-long project, you will be tasked to synthesize and update understandings of sustainability problems from experiences in-class on the underlying science and engineering (2.1) and learnings from customer discovery interviews to develop a solution for a sustainability challenge (2.2).

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Goal 3: Successful students will analyze and explain how social and natural systems function, interact, and evolve over time; how human well-being depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multifaceted potential solutions across time.

Sustainability ELO	Course ELO	Weeks	Assessment Activities
3.1 *Describe elements of the fundamental dependence of humans on Earth and environmental systems, and on the resilience of these systems.*	A.1-A.4	1-4, 10	Reflections, Quizzes, Solution Proposal
3.2 *Describe, analyze, and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, present, and future.*	A.1-A.4, D.1-D.3	1-4	Reflections, Quizzes, Final Project Deliverable
3.3. *Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.*	B.1-B.4, C.1-C.3, D.1-D.5	5-15	Course Project, Reflections

In lectures and readings, you will be exposed to the concepts necessary to engage in critical thinking about technical solutions to sustainability (3.1, 3.2), environmental science and engineering concepts to understand environmental mechanisms and the interaction between the ecosphere and technosphere (3.1, 3.2), and life-cycle thinking (3.2, 3.3). You will also be exposed Lean Launchpad methods, including customer-discovery interviews and business models, common tools to developing customer-focused solutions to problems (3.3). During the semester-long project, you will have an opportunity to develop a technical solution to an environmental problem (3.2) and understand the values of stakeholders to environmental problems as they influence technology design (3.3).

High-Impact Practices: Research & Creative Inquiry

This course also meets the expectations laid out for a high-impact Research & Creative Inquiry GE course. This is done through:

1. Students spend a significant time over the course of the semester while completing a course-length project in which students ideate, research, develop, and evaluate a solution to a sustainability challenge.
2. Students interact with the teaching team through regular in-class presentations with instructor feedback and work sessions in which the instructor will move between groups. Students also interact with other students through their work on the group project and while also providing feedback on draft versions of their project deliverables.
3. A scaffolded approach in which students are routinely introduced to a skill, given an opportunity to develop a version of a deliverable with that skill, present that deliverable to the instructor and the class for feedback, and then iterate on their deliverables to incorporate that feedback. This structure of learn, practice, receive feedback, iterate is built into the schedule for all deliverables with one exception (the carbon infographic does not include in-class time dedicated to iterating, but it will be included in the time in Week 13 for revising the business model canvas).
4. Students complete routine reflections on their growth as learners at seven times throughout the semester (indicated on the course schedule with a superscript b). In addition, students

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are explicitly tasked with summarizing and reflecting on feedback they receive from the instructor and their peers in iterating on their deliverables.

5. This course is explicitly built around a real-world sustainability challenge that varies from offering to offering – depending on on-going research the instructor is involved with. In addition, students have opportunities to interact with real-world stakeholders (through customer discovery interviews) to understand how their project fits into the broader context.

6. A public demonstration of competence will be done via a poster presentation of their work and to celebrate their successes over the course of the semester is scheduled to take place during the Tuesday and Thursday sessions of Week 14.

7. There is content on empathy for design (Week 7) and explicit requirements for students to put themselves in the shoes of potential customers or actors in order to create the value proposition diagrams required as part of the course project. In addition, students will also be exposed to demonstrate intercultural and inter-personal competence via the customer discovery interviews.

8. Students will also receive training in weeks one and two on how to operate in a group, establish group compacts, and how to provide constructive feedback. Course materials have also been designed with an eye towards pedagogical best practices (e.g., the use of structured notes) and inclusion for learners with diverse physical ability (e.g., slide decks will be provided after the class for students that may not be able to take notes) or with other access limitations (e.g., the use of free resources for most of the course readings, with the main textbook being placed on CarmenBooks to reduce cost).

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Course Schedule

Week	Day	Topic	Reading(s)*	Course ELOs
1	Mon	Defining Sustainability	EESD pp. 28-33, 38-51	A.1, A.2
	Tue	Skill Session: Estimating	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 2. Quantitative and Qualitative Methods Supporting Life-Cycle Assessment	A.4
	Wed	Sustainable Development & Growth	EESD pp. 8-20	A.1, A.2
	Thu	Skill Session: Group Dynamics & Contracts	Last, S. Technical Writing Essentials – Chapter 4. Teamwork and Communication	
2	Mon	*NO CLASS – MLK JR. Day*		
	Tue	Group Work Time: Establishing a Group Contract	No Reading	
	Wed	Challenging Resource Limits: Finding Sources & Efficiencies	EESD pp. 296-319	A.1
	Thu	Skill Session: Providing Feedback	No Reading	
3	Mon[a]	Life-Cycle Thinking	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 1. Life Cycles and Systems Thinking	A.3, A.4, D.1
	Tue	Skill Session: Developing a Product Life Cycle	No Reading	D.1, D.2
	Wed[b]	COURSE PROJECT TOPIC LECTURE	TBD – Depends on Topic	A.1, A.2
	Thu	COURSE PROJECT TOPIC LAB	TBD – Depends on Topic	A.1, A.2
4	Mon[a]	COURSE PROJECT TOPIC LECTURE	TBD – Depends on Topic	A.1, A.2
	Tue	Skill Session: Technical Writing – Memos	Wahlin, L. Fundamentals of Engineering Program Technical Communications – Chapter 5. Writing Common Technical Documents	E.3
	Wed	COURSE PROJECT TOPIC LECTURE	TBD – Depends on Topic	A.1, A.2
	Thu	Revise COURSE PROJECT TOPIC LAB Memo Workshop	No Reading	E.3
5	Mon[a]	Business Model Canvas	BMG pp. 14-44	B.1
	Tue	Skill Session: Ideation	BMG pp. 125-145	B.1, B.2, C.1
	Wed[b]	Value-Proposition Diagram	Osterwalder, A. *et al.* Value Proposition Design – Chapter 1. Canvas	B.2
	Thu	Group Work Time: Ideating a Solution	No Reading	B.1, B.2, C.1
6	Mon[a]	The Lean Launchpad Cycle	BMG pp. 244-261	B.1, B.2, C.1
	Tue	Skill Session:	BMG pp. 171-179	

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		Story Telling		
	Wed	Experiment Design	Testing pp. 29-52	C.2
	Thu	Group Idea Pitch Presentations	No Reading	C.1
7	Mon[a]	Empathy & Design	EESD pp. 862-867	B.2
	Tue	Group Work Time: Revise Pitches	No Reading	B.1, B.2, C.2
	Wed	Hypotheses for Business Models	Quine, W.V. and Ullian, J.S. *Hypothesis* in Introductory Readings in the Philosophy of Science	C.1
	Thu	Skill Session: Developing Hypotheses and Experiments	Testing pp. 53-58	C.1, C.2
8	Mon[a]	Business Ecosystems	BMG pp. 200-211	B.1
	Tue	Hypotheses and Experiments Presentations	No Reading	C.1, C.2
	Wed[b]	Customer Discovery Interviews	Talking pp. 31-43	E.1, E.2
	Thu	Group Work Time: Iterate on Hypotheses and Business Model	No Reading	B.1, B.2, C.1, C.2,
9	Mon[a]	Developing Customer Interview Questions	Talking pp. 44-58	C.2, E.1, E.2
	Tue	Draft Business Model Presentations – Set 1	No Reading	B.1, B.2, C.1, C.2
	Wed	Other Forms of Experiments	Testing pp. 69-60	C.1
	Thu	Draft Business Model Presentations – Set 2	No Reading	B.1, B.2, C.1, C.2
10	Mon[a]	The Sustainability Triangle	EESD pp. 820-830	A.3
	Tue	Group Work Time: Iterate on Business Models & Value Propositions	No Reading	B.1, B.2, C.1, C.2
	Wed[b]	Revenue & Cost Estimations	Matthews H.S., *et al.* Life Cycle Assessment – Chapter 3. Life Cycle Cost Analysis	A.3, A.4
	Thu	Group Work Time: Iterate on Business Models & Value-Propositions	No Reading	B.1, B.2, C.1, C.2
11	Mon[a]	Environmental Life-Cycle Assessment	EESD pp. 894-904	A.3, A.4, D.1
	Tue	Skill Session: Presenting Data	Wahlin, L. Fundamentals of Engineering Program Technical Communications – Chapter 4. Using Graphics and Visuals Effectively	E.3
	Wed	Estimating Product Carbon Emissions	EESD pp. 781-791	D.2, D.3
	Thu	Skill Session: Poster Design	No Readings	E.3
12	Mon[a]	Estimating Climate Impacts	EESD pp. 904-928	D.2
	Tue	Group Work Time:	No Readings	D.2, D.3

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		Carbon Reduction Infographic		
	Wed[b]	Modeling Uncertainty in Climate & Cost	Matthews, H.S. *et al.* Life Cycle Assessment – Chapter 2. Quantitative and Qualitative Methods Supporting Life-Cycle Assessment	D.2, D.3
	Thu	Carbon Reduction Infographic Presentation	No Readings	D.2, D.3
13	Mon[a]	Interpreting Interviews	Talking pp. 59-65 Testing pp. 59-67	C.3, E.4, E.5
	Tue	Group Work Time: Revise Business Model Canvas	No Readings	C.3, E.4, E.5
	Wed[b]	Segmenting the Market	Video – "How to Niche your Customer Segments: Finding your Early Adopters"	E.4, E.5
	Thu	Group Work Time: Revise Business Models Canvas	No Readings	C.3, E.4, E.5
14	Mon[a]	Customer Validation: Get, Keep, Grow Strategies	Videos – "Get Keep Grow" series from Steve Blank's *How to Build a Startup*	B.3
	Tue	Final Business Model Poster Presentations – Set 1	No Readings	B.1, B.2, C.3, E.4
	Wed	Customer Validation: Market Positioning	Article - "Market Positioning: 5 Types of Market Positioning Strategies"	C.3, E.4, E.5
	Thu	Final Business Model Poster Presentations – Set 2	No Readings	B.1, B.2, C.3, E.4
15	Mon[b]	Technology for a Sustainable Future	EESD pp. 1024-1051	A.1

In the day column, the superscript indicates the following:
    a: Quiz
    b: Reflection Due
In the readings columns, the textbooks are shortened as follows:
- "EESD" refers to *Environmental Engineering and Sustainable Design (2nd ed.)* by Striebig *et al.*
- "BMG" refers to *Business Model Generation* by Osterwalder & Pigneur
- "Talking" refers to *Talking to Humans* by Constable and Rimalovski
- "Testing" refers to *Testing with Humans* by Constable and Rimalovski

More details on course textbooks can be found below. Selections for other readings will be posted to Carmen.

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Grading and Faculty Response

How Your Grade is Calculated

Your grade for the course will come from in-class work, quizzes, and exams.

Assignment Category	Points Possible
In-Class Engagement	100
Weekly Quizzes	200
Module Reflections	150
Project	550
Total Points	**1000**

The total points earned over the course of the semester will be used to assign your grades, as shown in the table below

Points Earned	Letter Grade	Points Earned	Letter Grade
		770 ≤ Points < 800	C+
930 ≤ Points	A	730 ≤ Points < 770	C
900 ≤ Points < 930	A-	700 ≤ Points < 730	C-
870 ≤ Points < 900	B+	670 ≤ Points < 700	D+
830 ≤ Points < 870	B	600 ≤ Points < 670	D
800 ≤ Points < 830	B-	Points < 600	E

Descriptions of Major Course Assignments

In-Class Engagement and Preparation (100 Points Available)

Description: These assessments are designed to help you to prepare for class and to keep you engaged while in class. They will take two general forms throughout the semester:

- Reading Quizzes: Reading is an essential part of being prepared for class and helping me keep everyone engaged in class. To that end, reading assignments will be posted to Carmen and announced in class for every lecture class. These reading assignments will include sections to pay special attention to and guided reading questions. At the start of every lecture, I will have a TopHat question derived from a guided reading question to encourage you to engage with the work and come to class prepared. These questions will be graded on accuracy.

- Engagement Questions: These assessments may involve some TopHat quizzes in which you will make a prediction or submit results of calculations you have just made. They are designed to follow best pedagogical practices to keep you engaged in class and to provide me with real-time information that would allow me to adjust mid-lecture. As a result, their usefulness is specific to the session in which they take place. These questions will be graded for completion only, allowing you to make mistakes as you learn the material without penalty.

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Given that life happens and sometimes you may miss a class or two, I will automatically subtract three times the average number of TopHat points per day from the total number of TopHat points available, and set this as the maximum number of points available. As it is the maximum amount available, you will not be able to get more TopHat points than this. This will allow you to miss roughly three days of class without penalty or need to do make-up work. If you miss more than three days of class, I strongly encourage you to reach out to me to discuss alternate arrangements. The number of points you will get from this category will be the percent of TopHat points you have earned after this scaling process.

Weekly Quizzes (200 Points Available)

Description: There will be a quiz nearly every Monday of the course. These quizzes will be administered via Carmen. These quizzes are designed to assess your knowledge of course content and to help you keep pace with the class as we move forward. There will be a total of 12 quizzes throughout the course and I will drop your lowest two quiz scores for a total of ten graded quizzes, each worth a total of 20 points for a total of 200 points available.

Module Reflections (150 Points Available)

Description: After each module, you will be assigned a reflection assignment. These reflections will be opportunities for you to reflect on what you leaned in the module, your progress on the group project, how you might apply what you have learned to your group project, and the decisions your group is making as you progress in the project. Each reflection will be worth the same number of points (roughly 21.4 points).

Project (550 Points Available, breakdown below)

Description: Over the course of the semester, you will work as part of a group on a project to develop a possible solution for our sustainability challenge case study. Instructions on the project will be posted to Carmen and discussed in class. This project will be broken down into many different pieces throughout the course of the semester, several of which will include an in-class presentation of a draft and a written deliverable submission:

- *Experiment Memo (50 Points).* After the Lab Memo Revision workshop, you will submit a two-page memo describing and interpreting the results of the analysis. This is an individual submission.
- *Pitch Briefing (70 Points).* With your team you will submit a 2-3 page description of the technical solution you plan to study for the proposal, including a description of the piece of the challenge you plan to tackle, and the design process you went through as a team to come to this solution.
- *Hypotheses & Experiments (70 Points).* With your team you will submit a 2-3 page memo laying out your initial hypotheses in key areas of the business model and your answers to the experiment design template.
- *Draft Business Model Canvas and Value Proposition Diagram (100 Points).* Before starting your customer discovery interviews, you will present in-class and submit a draft of your business model canvas and a value proposition diagram for a specific customer segment that includes revised versions of your hypotheses.
- *Carbon Impact Infographic (60 Points).* As a team, you will estimate the climate impact of adopting your product and then create and present an infographic to communicate this impact.

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- *Final Project Deliverable (100 Points).* At the end of the semester, you will present a poster about your technology, its potential impact, and the changes you made to your initial solution over the course of the semester. You will also need to identify potential earlyvangelists, describe your get-keep-grow strategies for customer acquisition, and the impact of your solution.
- *Group Contract and Performance (50 Points).* At the beginning of the project, you will need to submit a group contract (20 points) laying out expectations for how your group will work together. At the end of the semester, you will need to submit a team evaluation (30 points) for how you all met the expectations laid out in the contract.
- *Peer Evaluations (50 Points).* Throughout the semester, you will provide feedback to your peers on their business models, value propositions, and deliverable documents. You will be graded on the quality of this feedback throughout to encourage you to give productive, meaningful feedback.

In addition to the content described for each deliverable above, all deliverables except for the Group Contract and Performance will also include grades on: (1) professionalism and style and (2) a summary of peer and instructor feedback, and (3) reflection on changes due to feedback provided by peers and the instructor.

By default, the grade for the pitch briefing, hypotheses & experiments memo, draft business model canvas and value proposition diagram, and carbon impacts infographics, and final project deliverable will be shared by all members of the group. If a team member does not contribute, please reach out to me to discuss next steps and resolution.

Attendance and Missed Assignments

Because their goal is to provide you and I with real-time information, I do not allow make-up work for in-class engagement and activities points except in extremely limited circumstances in which I am notified of in advance. As there will be many of these assessments throughout the semester, you should not worry if you miss a day or two of class. You will be fine. For longer absences, I strongly encourage you to talk to me so that we can develop a plan for how you can keep up with the class.

Instructor Feedback and Response Time

I am providing the following list to give you an idea of my intended availability throughout the course. Remember that you can call 614-688-4357 (HELP) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact me first through my Ohio State email address. I will reply to emails within **24 hours on days when class is in session at the university**. I will respond to emails sent between 5:00pm on Friday and 8:00am on Monday by Tuesday at 8:00am

- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to ensure you receive these messages.

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- **Discussion board:** I will check and reply to messages in the discussion boards once mid-week on Wednesday at 9:00am and once at the end of the week on Friday at 4:00pm.

- **Grading and feedback:** For the quizzes, you can generally expect feedback within **two class sessions**. For the projects, you can generally expect feedback within **three class sessions**.

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Course Materials, Fees, and Technologies

Required Materials and/or Technologies

There are four required textbooks for the course. I will assign readings from these books and expect you to do the assigned readings. This book is available through the CarmenBooks program. Instructions on how to access it can be found on Carmen.

- Striebig, B.A.; Papadakis, M.; Heine, L.G.; Ogundipe, A.A. (2023). Environmental Engineering and Sustainable Design (2nd ed.). Cengage, ISBN 978-0-357-67585-4.

DO NOT BUY THE FOLLOWING BOOKS. The first one is available online, free of charge through the Ohio State Library.

- Osterwalder, A. (2010). Business model generation : a handbook for visionaries, game changers, and challengers. Wiley, ISBN: 978-0-470-90103-8.

The last two books are available online as a free PDFs that I have posted to Carmen.

- Constable, G. (2014). Talking to Humans. ISBN: 978-0-9908009-0-3.
- Constable, G. (2018). Testing with Humans. ISBN: 978-0-9908009-4-1

In addition to these required books, there is one optional book that you may find helpful for more context on start-ups and the process of taking technology from customer discovery to market.

- Blank, S. and Dorf, B. (2012). The Startup Owners Manual: The Step-by-Step Guide to Building a Great Company. K&S Ranch, ISBN: 978-0984999309

CarmenCanvas Access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device (go.osu.edu/add-device) help article for step-by-step instructions.

- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.

- Install the Duo Mobile application (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

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Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat**: [go.osu.edu/it](go.osu.edu/it)
- **Phone:** [614-688-4357 (HELP)](tel:614-688-4357)
- **Email:** servicedesk@osu.edu

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Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class on Carmen's discussion boards. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.

- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.

- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.

- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

Academic Integrity Policy

See Descriptions of Major Course Assignments for specific guidelines about collaboration and academic integrity in the context of this class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's Code of Student Conduct (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

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If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. I believe that the COAM process is the best way to ensure that you receive due process in resolving allegations of academic misconduct. As a result, I will spend the time necessary to work with COAM in getting academic misconduct issues resolved. In my office I have a paleontology textbook because I really enjoy dinosaurs. If you send me a picture of a dinosaur by January 14th at 5:00pm, I will give you 2.5 percentage points of extra credit on Exam I. To protect the secrecy of the process, don't discuss this opportunity with your classmates. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. This does include materials developed by the instructor for the class (e.g., practice problems, quizzes, exams). Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options on Ohio State's Title IX website (titleix.osu.edu) or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information, visit the OIE website (equity.osu.edu) or email equity@osu.edu.

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Commitment to a Diverse and Inclusive Learning Environment

The Ohio State University affirms the importance and value of diversity of people and ideas. We believe in creating equitable research opportunities for all students and to providing programs and curricula that allow our students to understand critical societal challenges from diverse perspectives and aspire to use research to promote sustainable solutions for all. We are committed to maintaining an inclusive community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among all members; and encourages each individual to strive to reach their own potential. The Ohio State University does not discriminate on the basis of age, ancestry, color, disability, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, race, religion, sex, gender, sexual orientation, pregnancy, protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment.

To learn more about diversity, equity, and inclusion and for opportunities to get involved, please visit:

- https://odi.osu.edu/
- https://odi.osu.edu/racial-justice-resources
- https://odi.osu.edu/focus-on-racial-justice
- https://cbsc.osu.edu

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th floor of the Younkin Success Center and 10th floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

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Requesting Accommodations

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are isolating while waiting for a COVID-19 test result, please let me know immediately. Those testing positive for COVID-19 should refer to the Safe and Healthy Buckeyes site for resources. Beyond five days of the required COVID-19 isolation period, I may rely on Student Life Disability Services to establish further reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

This course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

Religious Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

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If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the [Office of Institutional Equity](#). (Policy: [Religious Holidays, Holy Days and Observances](#))

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GE Theme course submission worksheet: Sustainability

Overview

Courses in the GE Themes aim to provide students with opportunities to explore big picture ideas and problems within the specific practice and expertise of a discipline or department. Although many Theme courses serve within disciplinary majors or minors, by requesting inclusion in the General Education, programs are committing to the incorporation of the goals of the focal theme and the success and participation of students from outside of their program.

Each category of the GE has specific learning goals and Expected Learning Outcomes (ELOs) that connect to the big picture goals of the program. ELOs describe the knowledge or skills students should have by the end of the course. Courses in the GE Themes must meet the ELOs common for **all** GE Themes <u>and</u> those specific to the Theme, in addition to any ELOs the instructor has developed specific to that course. All courses in the GE must indicate that they are part of the GE and include the Goals and ELOs of their GE category on their syllabus.

The prompts in this form elicit information about how this course meets the expectations of the GE Themes. The form will be reviewed by a group of content experts (the Theme Advisory) and by a group of curriculum experts (the Theme Panel), with the latter having responsibility for the ELOs and Goals common to all themes (those things that make a course appropriate for the GE Themes) and the former having responsibility for the ELOs and Goals specific to the topic of **this** Theme.

Briefly describe how this course connects to or exemplifies the concept of this Theme (Sustainability)

In a sentence or two, explain how this class "fits' within the focal Theme. This will help reviewers understand the intended frame of reference for the course-specific activities described below.

(enter text here)

This class primarily (although not exclusively) focuses on the "Energy, Technology & Design" theme and the "Business, Economy & Governance" theme of the SELC model of sustainability by discussing environmental impacts of the technosphere (with a focus on a specific rotating challenge introduced in Week 4 of the class) and the role of technologists in addressing these impacts. Students are also introduced to techniques to understand the needs of customers in evaluating the suitability of technology and how to bring new, innovative technologies to market to reduce the impact of on-going human activities or to repair past harms.

Connect this course to the Goals and ELOs shared by *all* Themes

Below are the Goals and ELOs common to all Themes. In the accompanying table, for each ELO, describe the activities (discussions, readings, lectures, assignments) that provide opportunities for students to achieve those outcomes. The answer should be concise and use language accessible to colleagues outside of the submitting department or discipline. The specifics of the activities matter—listing "readings" without a reference to the topic of those readings will not allow the reviewers to understand how the ELO will be met. However, the panel evaluating the fit of the course to the Theme will review this form in conjunction with the syllabus, so if

readings, lecture/discussion topics, or other specifics are provided on the syllabus, it is not necessary to reiterate them within this form. The ELOs are expected to vary in their "coverage" in terms of number of activities or emphasis within the course. Examples from successful courses are shared on the next page.

Goal 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than the foundations. In this context, "advanced" refers to courses that are e.g., synthetic, rely on research or cutting-edge findings, or deeply engage with the subject matter, among other possibilities.

Goal 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

	Course activities and assignments to meet these ELOs
ELO 1.1 Engage in critical and logical thinking.	Throughout the course, students will be challenged to think deeply about sustainability challenges and reject simple technical solutions in lecture and readings and as the students engage in the semester-long projects. Lecture and Readings: Students will be exposed to the concepts necessary to engage in critical thinking about technical solutions to sustainability challenges as well as to think critically about the market need for new technologies. The relevant readings for the course will cover the principles of environmental science necessary to understand the fundamental mechanics of human activity on the environment, the grand challenges of sustainability, and in-depth readings specific to the social, environmental, and technical elements of the sustainability challenge being addressed throughout the Course (and introduced in Week 4). Semester-Long Project: Students will think critically as they evaluate their ideas, what they hear from potential stakeholders during the customer discovery interviews, and in response to presentations from other groups. Assessment Strategy: Student achievement of this learning objective will be assessed using several of the documents during the semester-long project (e.g., critical thinking about their solution in the solution proposal, critical thinking about the customer discovery interviews in their canvas documents), through guided reflection questions designed to have them reflect on their thinking process, and through weekly quizzes about the topics discussed throughout the semester.
ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or ideas within this theme.	Throughout the course, students will engage in in-depth study on a sustainability challenge (that changes from offering-to-offering, example challenges include decarbonizing energy for transportation, reducing water use in industrial processes in the state of Ohio, improving recycling rates for materials). This in-depth study will be done through a combination of lectures and readings and an in-class project to develop a solution to a sustainability challenge: Lectures and Readings: In weeks 1-4 of the class, students will be introduced to the environmental sciences and engineering that govern the mechanics of the challenge (e.g., the mechanics of global warming and energy use for the decarbonization challenge). This will be done in-class through lectures and readings from the textbook, other peer-reviewed sources, and documents written towards a professional audience in this space (e.g., *The Grand Challenges in Environmental Engineering* report from the National Academies). In weeks 3 and 10-12, students will be introduced to the concepts of life-cycle thinking and environmental life-cycle assessment as they engage in activities to quantify the environmental consequences of their

	solution using relevant readings from the textbook and other online textbooks for life-cycle assessment. Students will also engage in understanding the limitations and motivations of these approaches, through first-hand experience performing them and readings on the controversial usages of these techniques. Semester-Long Project: In the semester-long project, students will conduct independent research on the sustainability challenge, develop a solution to an element of the challenge, and understand the mechanisms by which their solution reduces environmental impacts. Assessment Strategy: Student achievement of this learning objective will be assessed using their semester-long project solution proposal document (where they will describe their mechanisms), guided reflection prompts to think about the process of exploring this challenge, and through the weekly quizzes in weeks 2, 3, 4, 10, 11, and 12.
ELO 2.1 Identify, describe, and synthesize approaches or experiences.	Throughout the course, students will learn about several metrics commonly used to quantify the environmental impacts of human activities and synthesize them with customer discovery approaches. This will be done through a combination of lectures and readings, in-class activities, and semester long projects built around the sustainability challenge for the course: Lectures and Readings: In weeks 2-4, and 10-11, students will be learning about grand challenges in sustainability, the particulars of the specific sustainability challenge tackled in our class, and sustainability metrics. Students will learn about these through lectures on these topics and readings for these topics from the course textbook and other reference materials. Students will also be tasked with conducting research as part of their group on these challenges and synthesize that with the other concepts they have learned in class. Semester-Long Project: As part of the semester-long project, students will be tasked to synthesize their in-class experiences, experiences developing a solution to the sustainability challenge, and learnings from customer discovery interviews in order to develop, present, and defend their solution to the sustainability challenge. Assessment Strategy: Student achievement of this learning objective will be assessed using their semester-long project canvas documents (where they will synthesize their learnings from interviews) and final deliverable where they will present on the impact of their proposed solution using quantified metrics for sustainability and learnings from interviews, guided reflection prompts to think about the process of exploring this challenge, and through many of the weekly quizzes where they will be assessed on different approaches to the sustainability challenge and measuring environmental impact.
ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.	Throughout the course, students will engage in creative inquiry and reflection around the semester-long project. Semester-Long Project: As part of the semester-long project, students will be tasked to develop a creative solution to the focal sustainability challenge using the customer discovery framework of the Lean Launchpad. This approach requires a participant to constantly reflect on their initial ideas of what customers need from their proposed solution, change their hypotheses when customers disprove student initial thoughts, and reflect on the process of doing customer discovery with a beginners' mind. They will also be tasked to reflect on feedback they receive and specify how they changed their work in response to this feedback for every project deliverable. Assessment Strategy: Student achievement of this learning objective will be assessed using several components of their semester-long project, including: (1) their revised value

	proposition diagram in which students have reflected on and changed their initial VPD based on learnings from the customer discovery interviews, (2) their final project poster presentation where they wil be assessed on how their solution fits the market needs and reflects changes made in response to these learnings, and through (3) seven, regular guided reflections to think about the process of doing and learning from stakeholders.

Goals and ELOs unique to Sustainability

Below are the Goals and ELOs specific to this Theme. As above, in the accompanying Table, for each ELO, describe the activities (discussions, readings, lectures, assignments) that provide opportunities for students to achieve those outcomes. The answer should be concise and use language accessible to colleagues outside of the submitting department or discipline. The ELOs are expected to vary in their "coverage" in terms of number of activities or emphasis within the course. Examples from successful courses are shared on the next page.

GOAL 3: Students analyze and explain how social and natural systems function, interact, and evolve over time; how human wellbeing depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors, and institutions impact multi-faceted, potential solutions across time.

	Course activities and assignments to meet these ELOs
ELO 3.1 Describe elements of the fundamental dependence of humans on Earth and environmental systems and on the resilience of these systems.	At several points in the course, students will be introduced to the structure of environmental systems, the principles of environmental science that govern their operation, and how human activities impact and rely on these systems. This will be done through lectures and readings. Lectures and Readings: In weeks 1-4 of the class, students will be introduced to the environmental sciences and engineering that govern the mechanics of the challenge (e.g., the mechanics of global warming and energy use for the decarbonization challenge). This will be done in-class through lectures and readings from the textbook, other peer-reviewed sources, and documents written towards a professional audience in this space (e.g., *The Grand Challenges in Environmental Engineering* report from the National Academies). In week 10, students will be introduced to the concepts of life-cycle thinking and environmental life-cycle assessment. Several of the metrics that students will be introduced to in week 10 will be resource consumption metrics, highlighting how human activities rely on resources from the natural environment as inputs. Assessment Strategy: Student achievement of this learning objective will be assessed using their semester-long project solution proposal document (where they will describe the mechanisms by which their proposed technical solution interacts with the environment), guided reflection prompts to think about the process of exploring this challenge, and through the weekly quizzes in weeks 2, 3, 4, and 10.

ELO 3.2 Describe, analyze and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, currently, and in the future.	Early in the course, students will be exposed to the historical impacts that human activity has had on the environment and led to the unsustainability of many human activities (e.g., the use of fossil fuels without carbon capture and sequestration leading to emissions of greenhouse gasses and global warming) as well as the sustainable development goals. Students will also be exposed to several emerging technical solutions to these challenges as part of Weeks 2-44. This will be done through lectures and readings and through the semester-long project: Lectures and Readings: In weeks 1-4 of the class, students will learn about the relevant history of several elements of the technosphere and their interaction with the ecosphere via resource consumption and pollution emissions. Students will also be exposed to current approaches to qualitatively think about these impacts over the life-cycle of technologies (in week 3) as part of the social and environmental bottom lines. Readings for these topics will come from the textbook and students will be tasked to find an popular press article talking about at least one emerging technology that will be addressed in a reflection prompt. Semester-Long Project: In the semester-long project, students will conduct independent research on the sustainability challenge, develop a technical solution to an element of the challenge, and be able to critically identify and discuss both the benefits and the drawbacks of their technical solution for the environment. Assessment Strategy: Student achievement of this learning objective will be assessed using their semester-long project final project deliverable (where they will describe the pros and cons of their proposed technology), guided reflection prompts to think about the impacts of existing and emerging technologies, and through the weekly quizzes in weeks 2, 3, and 4.
ELO 3.3 Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.	Students will be introduced to technical solutions to sustainability challenges, how technology is developed to meet stakeholder and user needs, how to measure the technologies impacts, and how to use stakeholder perspectives and quantifiable sustainable assessment metrics to understand how their proposed technology solution can address sustainability challenges. This will be done through lectures, readings, and the semester-long project. Lectures and Readings: In the lectures for weeks 5-9 and 13-15, students will be introduced to the Lean Launchpad framework to understand how stakeholder and user values and needs influence the design and use of technology to address sustainability challenges. Readings on the topics of customer discovery interview process and models will come from the Constable texts, *Talking With Humans* and *Testing With Humans*, that discuss how to interview individuals to assess values and needs and use these interviews as evidence in

	arguments about technology, as well as the Osterwalder text on the development of a business model canvas.
	In the lectures for weeks 10-12, students will be introduced to several metrics to quantify the environmental impact of their technology. Students are introduced to these metrics to use them as evidence in their semester-long project.
	<u>Semester-Long Project:</u> Over the course of the semester-long project, students will have multiple opportunities to understand the values and stakeholder needs as part of the customer discovery interview process and to quantify the potential environmental benefits of their process using sustainability metrics.
	<u>Assessment Strategy:</u> Students will be assessed on their ability to use evidence of impact (from the sustainability metrics) and user values (from customer discovery interviews) in their canvas documents and in their final poster presentation. Students will also be asked to reflect on the use of these pieces of evidence as part of the guided reflection questions throughout the semester.

Research & Creative Inquiry Course Inventory

Overview

The GE allows students to take a single, 4+ credit course to satisfy a particular GE Theme requirement if that course includes key practices that are recognized as integrative and high impact. Courses seeking one of these designations need to provide a completed Integrative Practices Inventory at the time of course submission. This will be evaluated with the rest of the course materials (syllabus, Theme Course submission document, etc). Approved Integrative Practices courses will need to participate in assessment both for their Theme category and for their integrative practice.

Please enter text in the boxes below to describe how your class will meet the expectations of Research & Creative Inquiry Courses. It may be helpful to consult the Description & Expectations document for this pedagogical practice or to consult with the OSU Office of Undergraduate Research and Creative Inquiry. You may also want to consult the Director of Undergraduate Studies or appropriate support staff person as you complete this Inventory and submit your course.

Please use language that is clear and concise and that colleagues outside of your discipline will be able to follow. You are encouraged to refer specifically to the syllabus submitted for the course, since the reviewers will also have that document Because this document will be used in the course review and approval process, you should be *as specific as possible*, listing concrete activities, specific theories, names of scholars, titles of textbooks etc.

Accessibility

If you have a disability and have trouble accessing this document or need to receive it in another format, please reach out to Meg Daly at daly.66@osu.edu or call 614-247-8412.

Pedagogical Practices for Research & Creative Inquiry

Course subject & number   ENVENG 3600

Performance expectations set at appropriately high levels (e.g. students investigate their own questions or develop their own creative projects). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Students will develop a creative technological solutions for a sustainability challenge. This is associated with course goals C and E around the use of customer discovery methodologies to understand the needs of potential users of the technology. These goals are primarily associated with the activities of the semester-long project and will be assessed using several graded components of the project (i.e., the solution proposal, the draft and revised canvases, the final project poster presentation).

Significant investment of time and effort by students over an extended period of time (e.g., scaffolded scientific or creative processes building across the term, including, e.g., reviewing literature, developing methods, collecting data, interpreting or developing a concept or idea into a full-fledged production or artistic work) Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

With the weekly lab sessions to build, practice, and iterate on important skills, students will be engaging in scaffolded learning towards the final project poster presentation. Early in the class, the lab session will be spent to help students improve their skills for effective teamwork and written communication. Once Lean Launchpad methods are introduced started in week 5, students will turn their attention to collecting data (in the form of learnings from customer discovery interviews) and then interpreting these data in order to propose a technical solution with a clear market need and initial adopters.

These activities are linked to Course Goals B, C, and E.

Interactions with faculty and peers about substantive matters including regular, meaningful faculty mentoring and peer support. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Students will routinely interact with their peers through their group project deliverable development and performing and analyzing customer discovery interviews and with their peers and faculty through the weekly lab sessions.

Adopting the Lean Launchpad approach, students are in teams in order to support each other while doing customer discovery interviews (with at least two students attending each interview: one to interview and one to take notes and serve as backup). These group support structures are essential to the customer discovery process by ensuring that students have team members that can support them in evaluating the learnings form the customer discovery process so that students can design products that better meet market needs.

In many of the weekly lab sessions, students will give short (5-10 minute presentations) about their technical solution (to learn how to pitch a product) and how to communicate about the market they plan to play into (to discuss their findings from the interviews). Following these presentations, students will have the opportunity to ask questions and provide feedback for the presenting group. After the students have a chance to ask their question, the faculty will provide feedback. This faculty feedback will include points to correct/address/reflect on for future presentations. Before this occurs, students will receive training on how to provide feedback (Week 2) and will be graded on the quality of their feedback.

Students will get frequent, timely, and constructive feedback on their work, iteratively scaffolding research or creative skills in curriculum to build over time. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

An essential component of the Lean Launchpad methodology (Goals B, D, and E), is that students develop hypotheses about their customers that are communicated in the form of business model and value proposition canvases and get-grow strategies, test these hypotheses through customer discovery interviews, and then revise the hypotheses based on learnings from these interviews.

This iterative process is implemented in this course through the scaffolded components of the course project and nearly all deliverables have at least four in-class days dedicated to them in which students: (1) learn skills, (2) apply skills and implement them, (3) present work for feedback, (4) iterate and incorporate feedback before submitting a revised version for additional feedback by the instructor that can be incorporated into the final poster presentation

Periodic, structured opportunities to reflect and integrate learning in which students interpret findings or reflect on creative work. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

Reflection on student progress will be performed on a routine basis through seven guided reflection question assessments in which students will be asked to reflect on specific aspects of the technology design and customer discovery processes.

Students will also be repeatedly asked to interpret interview and technology assessment findings (using quantitative sustainability metrics, Course Goals A and D, that are introduced in Weeks 10-12) in order to refine their understandings of the business environment their proposed technology will play into. Their interpretation (and re-interpretation) of their learnings from the customer discovery interviews will be essential in various assessments associated with the semester-long project, including the revised value proposition diagram and the final project deliverable (and through guided reflections built around helping students identify what hypotheses about their customers they are rejecting or iterating on based on their findings).

This is in addition to the strategy discussed above for scaffolding as revised submissions will also be explicitly instructed to identify revisions made on the basis of feedback.

Opportunities to discover relevance of learning through real-world applications (e.g., mechanism for allowing students to see their focused research question or creative project as part of a larger conceptual framework). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

In the first four weeks of the course, students will learn about the fundamental environmental science and sustainability challenges facing society (Related Course goals A and C). Students will also get a week-long introduction (week 4) into the challenge that they will be focusing on for their semester-long project so that they can place their project into the broader context of the challenge when drafting the solution proposal (and iterating on it for the final project deliverable).

Students will also be exposed to the real-world context and application of their project when doing customer discovery interviews and learning how people are actually engaging with and what individuals need for their technology in the real-world. Students will be asked to demonstrate these connections as part of the revised value proposition diagram and in the final project poster deliverable.

Public Demonstration of competence, such as a significant public communication of research or display of creative work, or a community scholarship celebration. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

The course project builds to a final poster presentation that will give students the opportunity to present their proposed technology and highlight how this proposed technology has changed since the student teams submitted their solution proposal earlier in the semester. These poster presentations will all take place at the same time and in the same space, allowing students to also celebrate the work they did over the course of the semester for the project.

Experiences with diversity wherein students demonstrate intercultural competence and empathy with people and worldview frameworks that may differ from their own. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

A critical component of the customer discovery process (Goals C and E) is to allow participants to empathize with potential users and stakeholders for a product and to receive feedback on how well they understand these users through reflecting and revising the hypotheses the participants are developing. This occurs through the customer discovery interviews in which students will interview 10-15 potential customers of their product to better understand their needs and values when it comes to the technical solution the students are proposing. Students ability to empathize with their potential future customers will be assessed through the revised value proposition diagram and the final project poster.

Explicit and intentional efforts to promote inclusivity and a sense of belonging and safety for students, (e.g. universal design principles, culturally responsible pedagogy). Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

During the lab sessions for weeks one and two, students will be introduced to best practices for developing teams and holding each other accountable for following group norms. This is embedded in the group contract assignment that is submitted as part of the semester-long project with an evaluative reflection on group dynamics (as a way of holding each other accountable) through the group performance review at the end of the course.

In these lab sessions, students will also be (re-)exposed to concepts on team dynamics and roles. Occasional guided reflection questions will ask students to think about how their team dynamics are working and if there are issues that should be addressed by the team. These reflections will also give the faculty an opportunity to see how groups are performing and to intervene if necessary to support the team.

Clear plan to market this course to get a wider enrollment of typically underserved populations. Please link this expectation to the course goals, topics and activities and indicate *specific* activities/assignments through which it will be met. *(50-500 words)*

In addition to normal new course marketing strategies (e.g., hanging fliers), the faculty instructor will use his network to publicize the course to other faculty to recommend to students. This includes faculty in the College of Engineering, as well as the network of Sustainability Institute Core Faculty (the lead instructor is core SI faculty) and the SI Educational communications team to broaden its reach. The team will also publicize the course, the project, and the course sustainability challenge in advance of the course starting to help students understand the real-world applications of the skills they will be learning in the course.