ENGINEERING FOR US ALL (e4usa)

2024/2025 Curriculum Summary

The Engineering for US All (e4usa) curriculum empowers, engages, and excites students to use what they know and find what they are passionate about to take control and boldly influence the world. Empowerment is built through an **awareness** of engineering in everyday life, the **diversity** of engineers, and by **interrogating** and **emphasizing** how engineering is embedded in **society**. Engagement occurs as students practice engineering design at multiple scales, considering local and global engineering design challenges. *e4usa* generates excitement as students are provided opportunities to design and create solutions in authentic, student-centered product development challenges. *e4usa* invites all schools, teachers, and students to participate fully regardless of their technical background or preparation.

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e4usa+ Making Course Description:

Empowerment

e4usa is an onramp for students to learn about engineering as a profession and a personal practice and increases student confidence to use engineering tools and thinking. Students will practice three systematic continuous improvement practices: consistent critical self-reflection, ethical action, and seeking feedback (e.g. performance data, mentoring, etc.). In the e4usa+Making course, students will examine historical and current engineers and trace their professional origins to create their own understanding of the value of diversity in engineering, as well as build their own identity as a confident problem solver.

Engagement

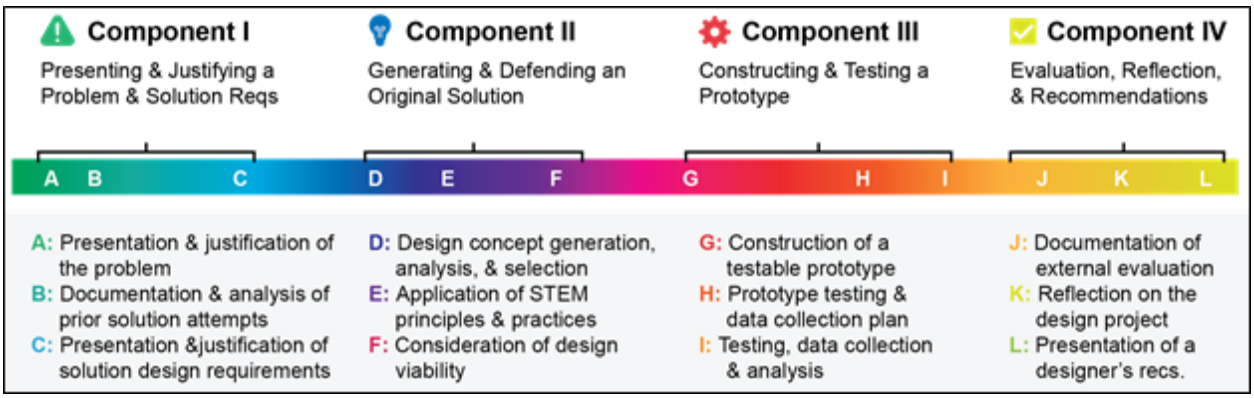
This course will explore the interplay among society's need for engineering, the intentions of engineers, and the positive and negative impacts of engineering. In multidisciplinary teams and individually, students will explore and embody various expert roles including both humanities and STEM-field experts as they grapple with humanity's grand challenges. Students will develop an appreciation for engineering solutions and their potential impact on society with attention paid to ethical implications.

Design Portfolio

Engineering design as a process, or design within constraint, is scaffolded in terms of a learning progression that can be practiced in *any* discipline. *e4usa* students will create basic engineering design process portfolios that document their work.

MyDesign® and the MyDesign rubric

Engineering design process portfolios are assessed formatively and summatively using the MyDesign Rubric. The rubric is comprised of four main components, each in turn comprised of three elements, as detailed in the figure below. Each element is broken down into a series of sub-elements that are scored on a scale of 0 (no evidence), 1 (novice), 2 (developing), 3 (proficient), 4 (advanced), and 5 (exemplary). With such a thorough focus on the details of the engineering design process, this rubric is useful in assessing student learning over the course of extended, complex projects. *e4usa* has moved MyDesign® into a classroom-ready tool. MyDesign® is an electronic engineering design process portfolio program, into which the MyDesign rubric described below is embedded, that integrates into local learning management systems and also functions as a stand-alone website.



Engineering Design Practices

Students will develop personal problem-solving agency by discovering a systematized method of engineering design that builds autonomy and mastery. Students will visualize and apply basic 2D and 3D drawing principles, create and edit engineering and CAD drawings that help them to communicate engineering ideas and designs effectively. Students will be introduced to a design process and will practice negotiating tradeoffs in design and valuing the input of multiple disciplinary expertise. Communication of results will occur in a school-wide 'innovation showcase' and in documentation through a digital design portfolio shared with the entire *e4usa* community.

Benefits and Requirements for Teachers

Curriculum and Support

The *e4usa* curriculum is holistic. The curriculum is a scaffold to teach engineering awareness, engineering in society, and engineering design practices through iterative design challenges, yet it invites teachers to incorporate their students' interests, local needs, community partners, and personal expectations. The *e4usa* curriculum scaffolds and includes room to leverage each teacher's own curriculum, tools, knowledge, and skill. It is, at its core, a set of rubrics and activities designed to promote engineering learning progressions.

Teacher Professional Development and Community of Practice

Professional Learning (PL) is a critical piece of *e4usa*. Each spring a webinar aims to introduce new teachers to the *e4usa* mission and the Curriculum, as well as provide a foundation for the summer workshop. Over the summer, teachers participate in either a synchronous virtual workshop or an in-person workshop with asynchronous assignments that provides teachers with meaningful opportunities to experience the course and also enhance both pedagogical and assessment skills. To ensure continued support, teachers will also receive a series of timely and responsive PLs throughout the academic year to further help with the implementation of the *e4usa* curriculum.

The PL workshops have established a Community of Practice, an actively managed network for both teachers and students. This network includes local faculty members and students from institutions of higher education, leaders in corporations and professional organizations, and *e4usa* team members. The Community of Practice allows teachers to ask questions of other engineers, collaboratively plan classroom activities, and provide high school students with mentorship and support.

Course Learning Outcomes

Connect With Engineering

CE.A	Iterate and evolve the definition of what it means to engineer and be an engineer.	
CE.B	Recognize the value of engineering for all regardless of one's potential career.	
CE.C	Explain and apply ethical & societal considerations when exploring an engineering problem.	

Engineering in Society

ES.A	Explore the impacts of past engineering successes and failures on society as a whole.	
ES.B	Recognize the world's greatest challenges and the role that engineering plays in solving these challenges (e.g., Engineering Grand Challenges, UN sustainability goals, etc.).	
ES.C	Integrate diverse disciplinary thinking and expertise to inform design solutions that add value to society.	

Engineering Professional Skills

PS.A	Use various engineering communication methods.	
PS.B	Transition from a group to a functional team	
PS.C	Develop and implement a project management plan.	

Engineering Design

ED.A	Identify and describe a local problem that can be solved with a potentially new product or process.	
ED.B	Identify appropriate stakeholders and content experts.	
ED.C	Plan and conduct research by gathering relevant and credible data, facts, and information.	
ED.D	Explore appropriate STEM practices and principles in the design.	
ED.F	Create a prototype.	
ED.G	Create a testing plan to evaluate the performance of design solutions.	
ED.H	Document the need to iterate in order to improve engineering designs.	

ED.I	~~R~~eflect on how an engineering design process could be applied to solving a problem.	
ED.J	Use appropriate engineering tools.	

e4usa + Making Curriculum Overview

The e4usa + Making curriculum is designed as a full-year course as detailed below. The expectation is for students to have approximately 200 minutes per week of instructional contact time. Schools working on block schedules should adjust the per week expectations accordingly.

Schools may require that their e4usa+Making students take an Industry Recognized Credential exam in a CAD program through this course.

Introducing Engineering

Students will explore engineering, developing their engineering identity and discovering the intersection of engineering, ethics and societal considerations. Students will also discover sketching and CAD as tools.

Unit: Engineering is… Everywhere

Students will explore engineering through the evolution of engineering products. They will define engineering by relating it to their future plans and engaging in two one-day challenges. Students will begin to build their engineering identity.

Unit: Engineering is…Creative

Students move from "group work" to "teamwork". The students then engage in a guided engineering challenge(s) tethered to a global issue in which they are provided a related problem and design, and then construct and test and evaluate product(s) to address a need. Students will explore sketching and CAD as engineering tools. The teacher will select either water filtration or wind turbine design.

Applying Engineering: Generating a solution to a local problem

Students will discover a systemic engineering design process and use that process to solve a local problem. Students will conclude by presenting their solutions.

Unit: Engineering is… Human-Centered

Teams of 3-4 students will select a local problem to research, sketch, and then prototype a solution. This will be an in-depth investigation into "What is the real problem" as well as stakeholder analysis. The goal is to understand the real problem, creatively construct a low-cost functional prototype and compare to existing solutions not necessarily refine, iterate, or 'deliver.'

Unit: Engineering is… Responsive

Prototypes will be presented at an in-school design-a-thon and to community partners for critical feedback and user input. Design details will be documented in students' engineering design process portfolios.

Unit: Engineering is… Reflective

Students will reflect on both their engineering design process decisions and work as well as their teamwork in their final project. Students will also take part in a public showcase of their work.

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