EYW I: Alignment with Iowa Standards

This document is intended to illustrate *EYW I*'s alignment with core engineering standards as well as standards in mathematics, social studies, literacy in technical subjects, and 21st Century Skills. If you have questions about how *EYW I* might address other standards, please contact the *Engineer Your World* team.

STEM Core Curricular Areas

Science HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. In one unit, students improve the earthquake resistance of a proposed building (see engineering grand challenge: improve urban infrastructure). They must find common ground and consider trade-offs between multiple project stakeholders; analyze and interpret requirements; and document design constraints that take into account the needs and wants of residents, owners and local government.

Science HS–ETS1–2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. Students "discover" the engineering design process in a constructivist unit guided by the teacher, apply it repeatedly throughout the year, and then transfer their understanding to a systems engineering challenge that requires nested design processes. In all cases, they are breaking a complex problem into smaller steps and applying a methodical process to address these steps.

Science HS–ETS1–3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. Students learn and practice several methods for evaluating solutions, including simple (Pugh) and complex (weighted) decision matrices, Six Thinking Hats, cost and safety analysis, and Failure Modes and Effects Analysis (FMEA) to inform concept selection.

Science HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. *Under development. The* Engineer Your World *team is working to develop a ray diagram simulator that students will use to verify the accuracy of their proposed internal pinhole camera dimensions prior to construction.*

Math (A-CED.A.2)(DOK1,2) Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Students draw the scaled similar triangles created by light passing through a small hole and write algebraic expressions relating the relationships between object height, distance from object, image height, and focal length.

Math (G-CO.D.12)(DOK 2) Make formal geometric constructions with a variety of tools and methods. Students construct a kinesthetic model to explore the similar triangles created by light passing through a small hole, then draw representations of these triangles both as standalone models and inscribed in a box.

Math (S-ID.B.6)(DOK 1,2) Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Students plot conductivity data to represent coffee brew strength over time under multiple conditions.

Math (S-ID.C.7)(DOK 1,2) Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. Students interpret slope of lines as indicators of experiment replicability and quality control.

Social Studies

Social Studies SS-Econ.9-12.14. Use cost-benefit analysis to argue for or against an economic decision. Students develop and defend a particular building redesign using arguments that explicitly reference tradeoffs between building height, cost, and safety.

Literacy (Reading and Writing) in Science and Technical Subjects

Reading in STEM (RST.9-10.3, RST.11-12.3) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. Students follow precise steps to carry out boundary condition experiments related to brewing coffee and testing conductivity. Because each condition is tested by three different teams, it is possible to identify outliers and analyze processes against instructions.

Writing in STEM (WHST.9-10.4, WHST.11-12.4.) Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Students organize material and write in different styles for different tasks, including somewhat informal contemporaneous documentation in engineering notebooks, formal explanatory texts (manufacturing instructions, user instructions) and persuasive texts (recommendations to manager, response to RFQ).

Writing in STEM (WHST.9-10.10, WHST.11-12.10.) Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. Formal reporting is written and revised over extended time frames, while contemporaneous notes in engineering notebooks are created daily and may be added to but not revised.

21st Century Skills

Employability (21.9-12.ES.1) Communicate and work productively with others, incorporating different perspectives and cross cultural understanding, to increase innovation and the quality of work. Students work in teams of 2-3 throughout the year, learning to communicate ideas, negotiate decisions, and incorporate multiple perspectives in their designs.

Employability (21.3-5.ES.2) Adjust to various roles and responsibilities and understand the need to be flexible to change. Students must take on multiple responsibilities on their teams. They must learn to adapt to unexpected outcomes and accept the necessity of resulting design changes.

Employability (21.9-12.ES.2) Adapt to various roles and responsibilities and work flexibly in climates of ambiguity and changing priorities. Students must fill a variety of roles on different project teams, and must learn to adapt to unexpected events such as teammate absences. The ambiguity of engineering design requires flexibility on the part of all team members.

Employability (21.9-12.ES.3) Demonstrate leadership skills, integrity, ethical behavior, and social responsibility while collaborating to achieve common goals. EYW teachers work with their students to establish classroom norms that serve as a code of conduct for the class, ensuring that certain core norms are included. Students must demonstrate integrity, ethics, and social responsibility to comply with these norms that govern collaboration, communication, and conduct.