Connections to Standards in Engineering

PLTW curriculum is designed to empower students to thrive in an evolving world. As a part of the design process when developing and updating our curriculum, we focus on connections to a variety of standards. PLTW Principles of Engineering connects to standards in the following:

Table of Contents

Common Core State Standards for English Language Arts Anchor Standards

Common Core ELA (Reading)

Key Ideas and details

CCSS.ELA-LITERACY.CCRA.R.1

Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☑	☑	☑	☑	☑

CCSS.ELA-LITERACY.CCRA.R.2

Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☑

Integration of Knowledge and Ideas

CCSS.ELA-LITERACY.CCRA.R.7

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☐	☑	☑	☑	☑	☑	☑	☐	☑	☑	☐	☐	☑	☑	☑	☑

CCSS.ELA-LITERACY.CCRA.R.8

Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☑	☑	☑	☐

Writing

Text Types and Purposes

CCSS.ELA-LITERACY.CCRA.W.1

Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☑	☑	☐	☑	☑	☐	☑	☐	☑	☑	☑	☑	☑

Common Core State Standards for English Language Arts Anchor Standards

CCSS.ELA-LITERACY.CCRA.W.2

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	☐	✔	✔	☐	✔	✔	☐	☐	☐	✔	✔	✔	✔	✔

Production and Distribution of Writing

CCSS.ELA-LITERACY.CCRA.W.4

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	☐	✔	✔	☐	✔	✔	☐	✔	☐	✔	✔	✔	✔	✔

CCSS.ELA-LITERACY.CCRA.W.5

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	✔	✔	✔	☐	✔	✔	☐	✔	✔	☐	☐	☐	✔	☐	✔	☐	✔

CCSS.ELA-LITERACY.CCRA.W.6

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	✔	✔	☐	☐	✔	✔	☐	✔	✔	☐	☐	☐	✔	☐	✔	☐	✔

Research to Build and Present Knowledge

CCSS.ELA-LITERACY.CCRA.W.7

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	☐	✔	☐	☐	✔	☐	✔	☐	☐	☐	☐	☐	✔	✔	✔	✔

CCSS.ELA-LITERACY.CCRA.W.8

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	☐	✔	☐	☐	✔	✔	✔	☐	✔	☐	☐	☐	✔	✔	✔	✔

Common Core State Standards for English Language Arts Anchor Standards

CCSS.ELA-LITERACY.CCRA.W.9

Draw evidence from literary or informational texts to support analysis, reflection, and research.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☐	☐	☐	☐	☑	☑	☑	☐	☑	☐	☐	☐	☑	☑	☑	☑

Range of Writing

CCSS.ELA-LITERACY.CCRA.W.10

Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☑	☑	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☑

Speaking and Listening

Comprehension and Collaboration

CCSS.ELA-LITERACY.CCRA.SL.1

Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☐	☑	☑	☑	☐	☑

CCSS.ELA-LITERACY.CCRA.SL.2

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☐	☑	☐	☐	☑	☑	☑	☐	☑	☐	☐	☐	☑	☑	☑	☐

CCSS.ELA-LITERACY.CCRA.SL.3

Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☑	☑	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☑	☑	☑	☑

Common Core State Standards for English Language Arts Anchor Standards

Presentation of Knowledge and Ideas

CCSS.ELA-LITERACY.CCRA.SL.4

Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	✔	✔	✔	✔	✔	✔	☐	✔	☐	✔	☐	☐	☐	✔	✔	✔	✔

CCSS.ELA-LITERACY.CCRA.SL.5

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	✔	☐	☐	✔	✔	✔	☐	✔	☐	☐	☐	☐	☐	☐	✔	☐	✔

CCSS.ELA-LITERACY.CCRA.SL.6

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	☐	☐	☐	☐	✔	✔	☐	✔	☐	☐	☐	☐	☐	☐	✔	☐	✔

Language

Convention of Standard English

CCSS.ELA-LITERACY.CCRA.L.1

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	✔	✔	✔	☐	✔	✔	☐	✔	☐	✔	✔	✔	✔	✔

CCSS.ELA-LITERACY.CCRA.L.2

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	✔	✔	✔	☐	✔	✔	✔	✔	☐	✔	✔	✔	✔	✔

Common Core State Standards for English Language Arts Anchor Standards

Vocabulary Acquisition and Use

CCSS.ELA-LITERACY.CCRA.L.6

Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☐	☑	☑	☐	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑

Quantities

Reason quantitatively and use units to solve problems.

CCSS.MATH.CONTENT.HSN-Q.A.1

Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☑	☑	☐	☑	☐	☐	☐	☐	☑	☑	☑	☑	☑	☐	☑	☑

CCSS.MATH.CONTENT.HSN-Q.A.2

Define appropriate quantities for the purpose of descriptive modeling.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑

CCSS.MATH.CONTENT.HSN-Q.A.3

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑

Vector and Matrix Quantities

Represent and model with vector quantities.

CCSS.MATH.CONTENT.HSN-VM.A.1

(+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐	☐	☑

CCSS.MATH.CONTENT.HSN-VM.A.3

(+) Solve problems involving velocity and other quantities that can be represented by vectors.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐	☐	☑

Common Core Standards for Mathematics

Seeing Structure in Expressions

Interpret the structure of expressions

CCSS.MATH.CONTENT.HSA-SSE.A.1

Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☑	☐	☐	☐

Creating Equations

Create equations that describe numbers or relationships

CCSS.MATH.CONTENT.HSA-CED.A.4

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law V = IR to highlight resistance R.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☑	☐	☑	☐

Reasoning with Equations and Inequalities

Solve equations and inequalities in one variable

CCSS.MATH.CONTENT.A-REI.B.3

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☐	☐	☑

Linear, Quadratic, and Exponential Models

Construct and compare linear, quadratic, and exponential models and solve problems

CCSS.MATH.CONTENT.HSF-LE.1.B

Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☐	☑	☐

Trigonometric Functions

Model periodic phenomena with trigonometric functions

CCSS.MATH.CONTENT.HSF-TF.B.7

(+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

Similarity, Right Triangles, and Trigonometry

Define trigonometric ratios and solve problems involving right triangles

CCSS.MATH.CONTENT.SRT.C.6

Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

CCSS.MATH.CONTENT.SRT.C.8

Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

Geometric Measurement and Dimension

Visualize relationships between two-dimensional and three-dimensional objects

CCSS.MATH.CONTENT.GMD.B.4

Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Common Core Standards for Mathematics

Modeling with Geometry

Apply geometric concepts in modeling situations

CCSS.MATH.CONTENT.MG.A.1

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

CCSS.MATH.CONTENT.MG.A.3

Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐	☑

Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on a single count or measurement variable

CCSS.MATH.CONTENT.HSS-ID.A.1

Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

CCSS.MATH.CONTENT.HSS-ID.A.3

Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Making Inferences and Justifying Conclusions

CCSS.MATH.CONTENT.HSS-IC.B.6

Evaluate reports based on data.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐

Using Probability to Make Decisions

Use probability to evaluate outcomes of decisions

CCSS.MATH.CONTENT.MD.B.7

(+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Next Generation Science Standards

Motion and Stability: Forces and Interactions

HS-PS2-1

Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐

HS-PS2-2

Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐

Energy

HS-PS3-1

Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

HS-PS3-3

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☑	☑	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐

Earth and Human Activity

HS-ESS3-1

Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐

Next Generation Science Standards

HS-ESS3-2

Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

HS-ESS3-4

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

Engineering Design

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.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☑	☐	☐

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.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☐	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑	☑

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.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☑	☐	☐	☑	☑	☐	☐	☐	☑	☑	☑	☑	☑

Next Generation Science Standards

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.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☑	☐	☑	☑

Disciplinary Core Ideas

Natural Resources

ESS3.A

Resource availability has guided the development of human society. (HS-ESS3-1)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

ESS3.A

All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

Developing Possible Solutions

ETS1.B

When evaluating solutions, it is important to take into acount a range of constraints,including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary HS-ESS3-4)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☐	☐	☑	☐	☐	☑	☐	☐	☑	☑	☑	☐	☑	☑	☑

Energy

Definitions of Energy

PS3.A

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐

Conservation of Energy and Energy Transfer

PS3.B

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐

PS3.B

Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐	☐	☐

Engineering Design

Defining and Delimiting Engineering Problems

ETS1.A

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☑	☐	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑

ETS1.A

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

Developing Possible Solutions

ETS1.B

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☑	☑	☐	☑	☑	☐	☑	☑	☑	☑	☑	☑	☑	☑

ETS1.B

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☑	☐	☑	☑	☐	☑	☐	☑	☐	☐	☑	☑	☑	☐	☑	☑

Optimizing the Design Solution

ETS1.C

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HSETS1-2)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☑	☑

Practice 1: Science and Engineering Practices

Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

Ask questions: - that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information - that arise from examining models or a theory, to clarify and/or seek additional information and relationships. - to determine relationships, including quantitative relationships, between independent and dependent variables. - to clarify and refine a model, an explanation, or an engineering problem.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☑	☑	☐	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑

Evaluate a question to determine if it is testable and relevant.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☐	☑	☐	☑	☑	☐	☐	☑	☑	☑	☐	☐	☐

Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐

Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☐	☑	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☑	☑	☐

Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☑	☑	☐	☐	☑	☑	☐	☑	☑	☑	☑	☐	☐	☐

Practice 2: Developing and Using Models: Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and desi

Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☑	☐

Design a test of a model to ascertain its reliability

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☑	☑	☑	☐	☑	☐

Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☑	☑	☐	☐	☑	☐	☑	☑	☑	☐	☑	☑	☑	☑	☑

Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☑	☐	☑	☑	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐

Develop a complex model that allows for manipulation and testing of a proposed process or system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☑	☑	☑	☑

Practice 3 Planning and Carrying Out Investigations Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical mo

Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☐	☑	☑	☐	☐	☑	☐	☐	☐	☑	☑	☑	☐	☑	☐

Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐

Select appropriate tools to collect, record, analyze, and evaluate data. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☐	☐	☑	☐	☐	☐	☐	☑	☑	☐	☐	☑	☐	☐	☐

Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐

Next Generation Science Standards

Manipulate variables and collect data about a complex model of a proposed process or system to identify failure points or improve performance relative to criteria for success or other variables

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐

Practice 4: Analyzing and Interpreting Data Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☑	☑	☐	☑	☐

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐	☐	☐

Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

Practice 5 Using Mathematics and Computational Thinking Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric f

Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐	☑	☐	☐	☑

Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑	☑	☐	☑	☑

Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3, acre-feet, etc.)

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐	☑	☑	☐	☐	☑	☐	☑	☑

Practice 6 Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated so

Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐

Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☑	☑	☑

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☑	☑	☐	☐

Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☐	☑	☐	☐	☑	☐	☐	☐	☑	☐	☑	☐	☑	☑	☐	☑

Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☐	☐	☑	☐	☑	☐	☑	☑	☑	☑	☑	☑

Practice 7 Engaging in Argument from Evidence Engaging in argument from evidence in 9-12 builds on K-8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about th

Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑

Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐	☑	☐	☐

Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐

Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☑

Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☑	☐	☑	☑	☐	☐	☐	☐	☐	☐	☑	☐	☑	☑	☐	☑

Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☐	☑	☐	☑	☑	☐	☐	☐	☑	☐	☐	☑	☑	☐	☑	☑	☑

Practice 8 Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☑	☐

Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

Crosscutting Concepts

Patterns – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

Mathematical representations are needed to identify some patterns.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑	☐	☑	☐	☑	☐

Empirical evidence is needed to identify patterns.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐	☑	☐	☐	☐

Next Generation Science Standards

Cause and Effect: Mechanism and Prediction – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐	☐

Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐

Systems can be designed to cause a desired effect.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☑	☑	☑	☑	☐	☑	☑	☑	☑	☑	☑	☑	☑

Changes in systems may have various causes that may not have equal effects

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐

Systems and System Models – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

Systems can be designed to do specific tasks.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☑	☑	☑	☑	☑	☐	☑	☑	☐	☑	☑	☑	☑	☑

Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☑	☑	☑	☐	☐	☐	☐	☐	☑	☐	☐	☑	☐	☐	☑

Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☑	☐	☑	☐	☐	☐	☐	☐	☑	☑	☐	☑	☐	☐	☑

Next Generation Science Standards

Energy and Matter: Flows, Cycles, and Conservation – Tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior

Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐

Structure and Function – The way an object is shaped or structured determines many of its properties and functions

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☑

The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☑

Stability and Change – For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand

Much of science deals with constructing explanations of how things change and how they remain stable.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐

Systems can be designed for greater or lesser stability.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐

Standards for Technological and Engineering Literacy

STEL 1 Nature and Characteristics of Technology and Engineering

STEL-1N

Explain how the world around them guides technological development and engineering design.

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	✔	☐	✔	✔	☐	✔	☐	✔	☐	☐	☐	✔	✔	✔	☐

STEL-1Q

Conduct research to inform intentional inventions and innovations that address specific needs and wants

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	✔	☐	✔	☐	✔	✔	☐	☐	✔	☐	☐	☐	☐	☐	☐	✔	✔	☐

STEL-1R

Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	✔	☐	✔	✔	✔	✔	☐	✔	✔	✔	☐	✔	✔	✔	☐	✔	✔

STEL 2 Core Concepts of Technology and Engineering

STEL-2T

Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	✔	✔	☐	✔	✔	✔	✔	✔	☐	☐	✔	☐	✔	✔

STEL-2U

Diagnose a flawed system embedded within a larger technological, social, or environmental system

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	✔	☐	☐	✔	☐	☐	☐	☐	☐	☐	✔	✔	☐

STEL-2V

Analyze the stability of a technological system and how it is influenced by all of the components in the system, especially those in the feedback loop

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	✔	✔	✔	☐	☐	☐	☐	☐	☐	☐	☐

Standards for Technological and Engineering Literacy

STEL-2W

Select resources that involve tradeoffs between competing values, such as availability, cost, desirability, and waste while solving problems

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☐	☑	☑	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☑	☑

STEL-2X

Cite examples of the criteria and constraints of a product or system and how they affect final design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☑	☑	☑	☑

STEL-2Y

Implement quality control as a planned process to ensure that a product, service, or system meets established criteria

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☑	☐	☐	☑	☐	☐	☐	☑	☑	☑	☑	☑	☐	☐	☐	☑

STEL-2Z

Use management processes in planning, organizing, and controlling work

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☑

STEL 3Integration of Knowledge, Technologies, and Practices

STEL-3J

Connect technological progress to the advancement of other areas of knowledge

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐

STEL 4 Impact of Technology

STEL-4P

Evaluate ways that technology can impact individuals, society, and the environment

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☑	☐	☑	☑	☐	☑	☐	☐	☑	☐	☐	☑	☑	☑	☑

STEL-4Q

Critique whether existing and proposed technologies use resources sustainably

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐

STEL-4R

Assess a technology that minimizes resource use and resulting waste to achieve a goal

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑

STEL-4S

Develop a solution to a technological problem that has the least negative environmental and social impact

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☐	☐

STEL-4T

Evaluate how technologies alter human health and capabilities

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☑	☐	☑	☐

STEL 5 Influence of Society on Technological Development

STEL-5H

Evaluate a technological innovation that arose from a specific society's unique need or want

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☑	☐	☑	☐	☐	☑	☐	☐	☐	☐	☐	☐	☑	☑	☑

STEL-5I

Evaluate a technological innovation that was met with societal resistance impacting its development

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐

STEL-5J

Design an appropriate technology for use in a different culture

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐

STEL 6 History of Technology

STEL-6F

Relate how technological development has been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☑	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☑	☐	☐

STEL-6G

Verify that the evolution of civilization has been directly affected by, and has in turn affected, the development and use of tools, materials and processes

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

STEL-6H

Evaluate how technology has been a powerful force in reshaping the social, cultural, political, and economic landscapes throughout history

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

STEL 7 Design in Technology and Engineering Education

STEL-7W

Determine the best approach by evaluating the purpose of the design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☑	☐	☑	☑	☑	☑	☑	☑	☑	☐	☑	☐	☑	☑	☑	☑	☑	☑

STEL-7X

Document trade-offs in the technology and engineering design process to produce the optimal design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☑	☑	☑	☐	☑	☐	☑	☐	☑	☐	☐	☑	☑	☑	☐	☑	☐

Standards for Technological and Engineering Literacy

STEL-7Y

Optimize a design by addressing desired qualities within criteria and constraints

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	✔	☐	✔	☐	✔	☐	☐	✔	✔	✔	✔	✔	✔	✔	✔

STEL-7Z

Apply principles of human-centered design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	✔	☐	✔	✔	☐	☐	✔	☐	✔	☐	☐	☐	☐	☐	✔	✔

STEL-7AA

Illustrate principles, elements and factors of design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	✔	✔	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐

STEL-7BB

Implement the best possible solution to a design

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
✔	☐	☐	✔	✔	☐	✔	✔	✔	✔	✔	☐	✔	✔	✔	✔	✔	✔	✔

STEL-7CC

Apply a broad range of design skills to their design process

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	✔	✔	✔	✔	✔	☐	✔	✔	✔	✔	✔	☐	☐	✔	✔	✔	✔

STEL-7DD

Apply a broad range of making skills to their design process

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	✔	✔	✔	✔	☐	✔	✔	✔	✔	✔	☐	✔	✔	✔	✔	☐

STEL 8 Applying, Maintaining, and Assessing Technological Products and Systems

STEL-8O

Develop a device or system for the marketplace

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☐	✔	☐	☐	✔	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	✔	☐

Standards for Technological and Engineering Literacy

STEL-8P

Apply appropriate methods to diagnose, adjust and repair systems to ensure precise, safe and proper functionality

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☑	☐	☐	☑	☑	☑	☑	☑	☑	☑	☑	☐	☐	☐	☐	☑	☐	☑	☑

STEL-8Q

Synthesize data and analyze trends to make decisions about technological products, systems or processes

0.1	0.2	0.3	0.4	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4
☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☑	☐

References

International Technology and Engineering Educators Association. (2020). *Standards for technological and engineering literacy: The role of technology and engineering in STEM education*. Retrieved from https://www.iteea.org/STEL.aspx

National Governors Association Center for Best Practices, & Council of Chief State School Officers. (2010). *Common Core State Standards*. Washington, DC: National Governors Association Center for Best Practices, Council of Chief State School Officers. Retrieved from http://www.corestandards.org/read-the-standards/

Next Generation Science Standards: For States, By States. (2019). *Read the Standards*. Retrieved fror https://www.nextgenscience.org/search-standards