

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 Civil Engineering and Architecture connects to standards in the following:

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Common Core State Standards for English Language Arts Anchor Standards

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Craft and Structure

CCSS.ELA-LITERACY.CCRA.R.4

Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Range of Reading and Level of Text Complexity

CCSS.ELA-LITERACY.CCRA.R.10

Read and comprehend complex literary and informational texts independently and proficiently.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Writing

Text Types and Purposes

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core State Standards for English Language Arts Anchor Standards

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.CCRA.W.5

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.CCRA.W.6

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☐	☐	☐	☒	☐	☐	☒	☐	☒	☐

CCSS.ELA-LITERACY.CCRA.W.9

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core State Standards for English Language Arts Anchor Standards

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.CCRA.SL.2

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☐	☒	☒	☒	☐	☒	☒	☐	☒	☒

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core State Standards for English Language Arts Anchor Standards

Language

Conventions of Standard English

CCSS.ELA-LITERACY.CCRA.L.1

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.CCRA.L.2

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Knowledge of Language

CCSS.ELA-LITERACY.CCRA.L.3

Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Vocabulary Acquisition and Use

CCSS.ELA-LITERACY.CCRA.L.4

Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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 encountering an unknown term important to comprehension or expression.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core Standards for Mathematics

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSN.Q.A.3

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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., $\mathbf{v}$, $|\mathbf{v}|$, $\|\mathbf{v}\|$, v).

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSN.VM.A.3

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Perform Operations on Vectors

CCSS.MATH.CONTENT.HSN.VM.A.4

(+) Add and subtract vectors.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core Standards for Mathematics

Creating Equations

Create Equations That Describe Numbers Or Relationships

CCSS.MATH.CONTENT.HSA.CED.A.1

Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSA.CED.A.2

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSA.CED.A.3

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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 .

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Reasoning with Equations and Inequalities

Solve Equations and Inequalities in One Variable

CCSS.MATH.CONTENT.HSA.REI.B.3

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSA.REI.B.4

Solve quadratic equations in one variable.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core Standards for Mathematics

Solve Systems of Equations

CCSS.MATH.CONTENT.HSA.REI.B.6

Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Interpreting Functions

Analyze Functions Using Different Representations

CCSS.MATH.CONTENT.HSF.IF.C.7.B

Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Building Functions

Build a Function That Models a Relationship Between Two Quantities

CCSS.MATH.CONTENT.HSF.BF.A.1

Write a function that describes a relationship between two quantities.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSF.BF.A.1.A

Determine an explicit expression, a recursive process, or steps for calculation from a context.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Modeling with Geometry

Apply Geometric Concepts In Modeling Situations

CCSS.MATH.CONTENT.HSG.MG.A.2

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.MATH.CONTENT.HSG.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).

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core Standards for Mathematics

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Common Core English Language Arts Standards

Reading Informational Text (11-12)

Integration of Knowledge and Ideas

CCSS.ELA-LITERACY.RI.11-12.7

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Writing (9-10)

Text Types and Purposes

CCSS.ELA-LITERACY.W.9-10.2

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.W.9-10.2.D

Use precise language and domain-specific vocabulary to manage the complexity of the topic.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Production and Distribution of Writing

CCSS.ELA-LITERACY.W.9-10.4

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Speaking and Listening (9-10)

Comprehension and Collaboration

CCSS.ELA-LITERACY.SL.9-10.1

Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core English Language Arts Standards

CCSS.ELA-LITERACY.SL.9-10.1.A

Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.SL.9-10.1.B

Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, presentation of alternate views), clear goals and deadlines, and individual roles as needed.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.SL.9-10.1.C

Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐

Presentation of Knowledge and Ideas

CCSS.ELA-LITERACY.SL.9-10.4

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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CCSS.ELA-LITERACY.SL.9-10.5

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Common Core English Language Arts Standards

Language (9-10)

Vocabulary Acquisition and Use

CCSS.ELA-LITERACY.L.9-10.6

Acquire and use accurately 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Science & Technical Subjects (9-10)

Key Ideas and Details

CCSS.ELA-LITERACY.RST.9-10.3

Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Craft and Structure

CCSS.ELA-LITERACY.RST.9-10.4

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Integration of Knowledge and Ideas

CCSS.ELA-LITERACY.RST.9-10.7

Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

Earth and Human Activity

HS.ESS3.4

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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HS.ESS3.6

Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Engineering Design

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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Disciplinary Core Ideas

ETS1.A Engineering Design - Defining and Delimiting Engineering Problems

- 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. (secondary to HS-PS2- 3)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

- 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)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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ETS1.B Engineering Design - Developing Possible Solutions

- 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)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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ETS1.C Engineering Design - Optimizing the Design Solution

- 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 (tradeoffs) may be needed. (secondary to HS-PS1-6)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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LS4.D Biological Evolution: Unity and Diversity - Biodiversity and Humans

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7) (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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ESS3.A Earth and Human Activity - Natural Resources

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- 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)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

ESS3.C Earth and Human Activity - Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Science and Engineering Practices

Practice 1 - 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 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

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 designed worlds.

- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- Develop a complex model that allows for manipulation and testing of a proposed process or system.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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 models.

- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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 functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- 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.).

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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 sources of evidence consistent with scientific ideas, principles, and theories.

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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- 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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Next Generation Science Standards

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 the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- 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).

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Crosscutting Concepts

Structure and Function

The way an object is shaped or structured determines many of its properties and functions.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Standards for Technological and Engineering Literacy

STEL 1 Nature and Characteristics of Technology and Engineering

STEL-1O

Assess how similarities and differences among scientific, mathematics, engineering, and technological knowledge and skills contributed to the design of a product or system.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☐	☐	☐	☒	☒	☐	☐	☐	☒	☐

STEL-1Q

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-1R

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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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.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-2W

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-2X

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Standards for Technological and Engineering Literacy

STEL-2Z

Use management processes in planning, organizing, and controlling work.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL 4 Impacts of Technology

STEL-4P

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-4Q

Critique whether existing or proposed technologies use resources sustainably.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL 5 Influence of Society on Technological Development

STEL-5J

Design an appropriate technology for use in a different culture.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL 6 History of Technology

STEL-6H

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL 7 Design in Technology and Engineering Education

STEL-7Y

Optimize a design by addressing desired qualities within criteria and constraints.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-7Z

Apply principles of human-centered design.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Standards for Technological and Engineering Literacy

STEL-7AA

Illustrate principles, elements and factors of design.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-7BB

Implement the best possible solution to a design.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-7CC

Apply a broad range of design skills to their design process.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

STEL-7DD

Apply a broad range of making skills to their design process.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL 8 Applying, Maintaining, and Assessing Technological Products and Systems

STEL-8N

Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-8O

Develop a device or system for the marketplace.

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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STEL-8P

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
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Standards for Technological and Engineering Literacy

STEL-8Q

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

1.1	1.2	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2
☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐

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