SAN LEANDRO UNIFIED SCHOOL DISTRICT
COURSE PROPOSAL: Course of Study
SECTION A. COVER PAGE

1. **Course Title: Introduction to Engineering, Design, and Invention**	7. **Action** ▢New Course ▢ Course Revision ▢ Title Change Only
2. Date Submitted: November 1, 2018	8. **Grade Level**(s) ▢ 6 ▢9 ▢11 ▢ 7 ▢10 ▢12 ▢ 8
3. Transcript Title/Abbreviation(s)	**9. Prerequisites** (Please list.) ▢ Required ▢ Recommended Enrolled in Algebra 1 or Geometry Math
4. Transcript Course Code/Course Number :	**10. Seeking Program Distinction?** ▢ YES (Check one below.) ▢NO ▢Honors ▢ AP ▢Other
5. Subject Area College-Preparatory Elective ("g") / CTE	11. **Is this a CTE course?** ▢ YES ▢ NO **If YES, complete Section C**
6. **Department** Career Technical Education	12. **Previously approved by UC?** ▢ YES ▢ NO ▢ NA for 6th-8th Year approved Year removed
13. UC ELIGIBILITY **Already eligible?** ▢ NA for 6th-8th ▢**YES** ▢**NO** **a** ▢ **b**▢ **c**▢ **d**▢ **e**▢ **f**▢ **g**▢ **Proposing eligibility?**▢ NA for 6th-8th **XYES** ▢**NO** **a** ▢ **b**▢ **c**▢ **d**▢ **e**▢ **f**▢ **g**X Please mark one for approved eligibility or proposed eligibility.	14. **Unit Value/Course Credit/Length of Course** ▢ 0.5 (semester or half-year ▢ 1.0 (one year equivalent) ▢ 2.0 (two-year equivalent) ▢ Other
15. School Contact and Course Developer Name: Eduardo Nava Phone: (510) 877-0947 Email: enava@slusd.us Position: Educator	
	DISTRICT OFFICE USE ONLY **Date approved by Board Curriculum Committee 1/15/19** **Date approved by Board**

16. Approval Signatures: Department Chair Principal: Principal:	Approval Date: 1/10/19

SECTION B. COURSE CONTENT

17. Course Description

Introduction to Engineering, Design and Innovation is the introductory course for the Product Development Pathway. In this course, students will express themselves visually and be able to showcase their creativity. Instruction will be given in the following areas of engineering and design: elements of design, design history, technical sketching including orthographic projection, dimensioning, perspective drawing, 2 point perspective drawing, and hand drawn 2D and 3D representations. Students will also explore sustainable design, clean energy and computer aided design. Students will experience design problems related to the vocational fields in construction architecture, interior design and engineering, examine trade-related occupations; and global human impact.

18. Course Goals and/or Major Student Outcomes

1. Apply the Design Process
2.Create technical sketches and drawings
3.Create engineering documentation and demonstrate drawing standards
4.Demonstrate proper measurement and statistical analysis
5.Use applied geometry
6.Create 3D CAD solid models
7.Complete and reverse engineering project
8.Design a product based on a client's wants
9.Participate in a virtual design challenge
10.Demonstrate presentation design and delivery

19. Course Objectives (standards)

See Exhibit A
https://www.cde.ca.gov/ci/ct/sf/documents/manproddev.pdf

20. Course Outline

See Exhibit B

21. Instructional Materials:
Board approved required text

Supplementary materials

AutoDesk CAD Software, AutoDesk INC, students.autodesk.com

22. Instructional Methods and/or Strategies (Key Assignments)

1) History of Design Report
2) Design Process Report
3) 2-D Portfolio
4) Spacial Design Project
5) Blueprint Design Project
6) Flat- Pack Design Project
7) Reverse Engineering Project
8) Green Design Project

23. Assessment Methods and/or Tools

Grades will be calculated on a straight point basis. Projects will be based on a scale of 1 to 100 points depending on the assignment or project. Daily work and participation grades will be based on completion of the Engineering Notebook and Portfolio. Weekly quizzes, cumulative unit exams and a National PLTW Assessment will be given during the semester. All students must maintain an Engineering Notebook and Portfolio to pass the class. They will be checked periodically throughout semester.

24. Grading Policy
Grading will follow the San Leandro Unified School District's policy.
All grades letter and percentage will be as follows:

100+ - 89% / Excellent
88 - 79% / Above Average
78 - 69% / Average
68 - 60%/ Below Average

Below 60%/ Failure
Grading is weighted as follows:
Class Participation & Professionalism 30%
Project Assignments 60%
Project Book 10%

SECTION C

25. Context for Course (optional)

REQUIRED FOR CTE COURSES

NOTE: In order to understand the context for a new course, sometimes it is helpful to understand the broader educational program and/or reform efforts of the school. How does this course fit into broader departmental and/or pathway structure? How does it fit into the overall school restructuring plans? Is the course intended to be a core course or supplemental? What are the student/school/community needs met by this course?

We are revising our Advanced Manufacturing and Engineering program and creating a Product Development Pathway. This course is designed to feed students into multiple Pathways in our CTE department. We hope to expand our efforts with recruitment and to build sustainable pathway structures that introduce students into our pathways. This is an introductory course that students can take at any grade level and is supplemental.

This course creates exposure to engineering, design, and manufacturing careers.

26. History of Course Development (optional)

REQUIRED FOR CTE COURSES

NOTE: Likewise, it is sometimes helpful know the origins of a course and who was involved in its development. Was this course modeled after another course at another school? If so, is that course UC approved? How does the course being submitted differ from the course after which it was modeled? Has this course received any special recognitions, designations or awards? Has it been articulated to local community colleges or universities?

This course was modeled after the Introduction to Engineering Design course at Great Oak High School. That course is UC approved. It was slightly modified to generalize the software utilized and to emphasize more on product design and less on architecture.

Exhibit A

Course Objectives (Standards):

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 1

AS.R.1 - Reading

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. AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently. AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.5 - Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach. AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. AS.W.8 - Writing

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Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.4 - Speaking and Listening

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. AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. AS.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate. AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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

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vocabulary knowledge when considering a word or phrase important to comprehension or expression. 9-10.W.1 - Writing

Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. 9-10.W.1.a - Writing

Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence. 9-10.W.1.b - Writing

Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns. 9-10.W.1.c - Writing

Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 9-10.W.1.d - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.1.e - Writing

Provide a concluding statement or section that follows from and supports the argument presented. 9-10.W.2.a - Writing

Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.W.2.b - Writing

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

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9-10.W.2.f - Writing

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.5 - Writing

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 9-10.W.7 - Writing

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 9-10.W.8 - Writing

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. 9-10.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research. 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.SL.4 - Speaking and Listening

Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization,

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development, substance, and style are appropriate to purpose, audience, and task. 9-10.SL.5 - Speaking and Listening

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. 9-10.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. 9-10.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.RST.8 - Reading Science/Technical

Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. 9-10.WHST.1 - Writing HS/S/T

Write arguments focused on discipline-specific content. 9-10.WHST.1.a - Writing HS/S/T

Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. 9-10.WHST.1.b - Writing HS/S/T

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Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns. 9-10.WHST.1.c - Writing HS/S/T

Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 9-10.WHST.1.d - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.1.e - Writing HS/S/T

Provide a concluding statement or section that follows from or supports the argument presented. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.2.f - Writing HS/S/T

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.WHST.4 - Writing HS/S/T

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Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.5 - Writing HS/S/T

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. 9-10.WHST.7 - Writing HS/S/T

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 9-10.WHST.8 - Writing HS/S/T

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. 9-10.WHST.9 - Writing HS/S/T

Draw evidence from informational texts to support analysis, reflection, and research. 9-10.WHST.10 - Writing HS/S/T

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.

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Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 2

AS.L.6 - Language

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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.

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Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 3

AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.L.6 - Language

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. 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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,

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texts, and issues, building on others' ideas and expressing their own clearly and persuasively. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.RST.7 - Reading Science/Technical

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. 9-10.WHST.10 - Writing HS/S/T

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.

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Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 4

AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2.a - Writing

Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.W.2.b - Writing

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

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Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.2.f - Writing

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.10 - Writing

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. 9-10.SL.5 - Speaking and Listening

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. 9-10.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.RST.7 - Reading Science/Technical

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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. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.2.f - Writing HS/S/T

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.WHST.4 - Writing HS/S/T

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.10 - Writing HS/S/T

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 5

AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. 9-10.L.6 - Language

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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. 9-10.RST.3 - Reading Science/Technical

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. 9-10.RST.4 - Reading Science/Technical

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 6

AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.4 - Speaking and Listening

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. AS.SL.5 - Speaking and Listening

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

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AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.SL.4 - Speaking and Listening

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. 9-10.SL.5 - Speaking and Listening

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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. 9-10.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

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Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.4 - Writing HS/S/T

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.10 - Writing HS/S/T

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 7

AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. AS.L.1 - Language

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Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2 - Writing

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. 9-10.W.2.a - Writing

Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.W.2.b - Writing

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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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. 9-10.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.RST.7 - Reading Science/Technical

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. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

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Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.4 - Writing HS/S/T

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.10 - Writing HS/S/T

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 8

AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2 - Writing

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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. 9-10.SL.1 - Speaking and Listening

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. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 9

AS.R.1 - Reading

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. AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. AS.R.10 - Reading

Read and comprehend complex literary and informational texts independently and proficiently. AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. AS.W.7 - Writing

Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation. AS.W.8 - Writing

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. AS.W.9 - Writing

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Draw evidence from literary or informational texts to support analysis, reflection, and research. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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. AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.4 - Speaking and Listening

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. AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. AS.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate. AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2 - Writing

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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. 9-10.W.2.a - Writing

Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.W.2.b - Writing

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.2.f - Writing

Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.7 - Writing

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 9-10.W.8 - Writing

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. 9-10.W.9 - Writing

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Draw evidence from literary or informational texts to support analysis, reflection, and research. 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.SL.1.b - Speaking and Listening

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. 9-10.SL.1.c - Speaking and Listening

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. 9-10.SL.1.d - Speaking and Listening

Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented. 9-10.SL.4 - Speaking and Listening

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. 9-10.SL.5 - Speaking and Listening

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. 9-10.SL.6 - Speaking and Listening

Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. 9-10.L.1 - Language

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

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9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.RST.4 - Reading Science/Technical

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. 9-10.WHST.1 - Writing HS/S/T

Write arguments focused on discipline-specific content. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.2.f - Writing HS/S/T

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Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.WHST.4 - Writing HS/S/T

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.7 - Writing HS/S/T

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 9-10.WHST.8 - Writing HS/S/T

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. 9-10.WHST.9 - Writing HS/S/T

Draw evidence from informational texts to support analysis, reflection, and research. 9-10.WHST.10 - Writing HS/S/T

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for English Language Arts

Unit 10

AS.R.7 - Reading

Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. AS.W.2 - Writing

Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. AS.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. AS.W.6 - Writing

Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. AS.W.8 - Writing

Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. AS.W.9 - Writing

Draw evidence from literary or informational texts to support analysis, reflection, and research. AS.W.10 - Writing

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. AS.SL.1 - Speaking and Listening

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.

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AS.SL.2 - Speaking and Listening

Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. AS.SL.5 - Speaking and Listening

Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations. AS.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. AS.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. AS.L.6 - Language

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. 9-10.W.2 - Writing

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. 9-10.W.2.a - Writing

Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.W.2.b - Writing

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.W.2.d - Writing

Use precise language and domain-specific vocabulary to manage the complexity of the topic. 9-10.W.2.e - Writing

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.W.2.f - Writing

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Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic). 9-10.W.4 - Writing

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.) 9-10.W.10 - Writing

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. 9-10.SL.1 - Speaking and Listening

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. 9-10.SL.5 - Speaking and Listening

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. 9-10.L.1 - Language

Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. 9-10.L.2 - Language

Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. 9-10.L.2.c - Language Spell correctly. 9-10.L.6 - Language

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. 9-10.WHST.2 - Writing HS/S/T

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. 9-10.WHST.2.a - Writing HS/S/T

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Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. 9-10.WHST.2.b - Writing HS/S/T

Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. 9-10.WHST.2.d - Writing HS/S/T

Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers. 9-10.WHST.2.e - Writing HS/S/T

Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. 9-10.WHST.4 - Writing HS/S/T

Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 9-10.WHST.10 - Writing HS/S/T

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 2

G.MG.1 - Modeling with Geometry

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

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 3

N.Q.1 - Quantities

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. N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. A.CED.3 - Creating Equations

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non- viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. F.IF.7.a - Interpreting Functions

Graph linear and quadratic functions and show intercepts, maxima, and minima. G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). S.ID.1 - Interpreting Categorical and Quantitative Data

Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.4 - Interpreting Categorical and Quantitative Data

Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 4

N.Q.1 - Quantities

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. N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. A.SSE.1 - Seeing Structure in Expressions

Interpret expressions that represent a quantity in terms of its context. A.SSE.1.a - Seeing Structure in Expressions

Interpret parts of an expression, such as terms, factors, and coefficients. A.CED.1 - Creating Equations

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. A.CED.2 - Creating Equations

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.CED.4 - Creating Equations

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. A.REI.3 - Reasoning with Equations and Inequalities

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. A.REI.10 - Reasoning with Equations and Inequalities

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Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). F.IF.1 - Interpreting Functions

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. the graph of f is the graph of the equation y = f(x). F.IF.2 - Interpreting Functions

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F.IF.5 - Interpreting Functions

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. F.IF.6 - Interpreting Functions

Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. F.IF.7.a - Interpreting Functions

Graph linear and quadratic functions and show intercepts, maxima, and minima. F.BF.1 - Building Functions

Write a function that describes a relationship between two quantities. F.LE.5 - Linear, Quadratic, and Exponential Models

Interpret the parameters in a linear or exponential function in terms of a context. G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). G.MG.3 - Modeling with Geometry

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). S.ID.6 - Interpreting Categorical and Quantitative Data

Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. S.ID.6.a - Interpreting Categorical and Quantitative Data

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Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. S.ID.6.c - Interpreting Categorical and Quantitative Data

Fit a linear function for a scatter plot that suggests a linear association. S.ID.7 - Interpreting Categorical and Quantitative Data

Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. S.ID.8 - Interpreting Categorical and Quantitative Data

Compute (using technology) and interpret the correlation coefficient of a linear fit. S.IC.1 - Making Inferences and Justifying Conclusions

Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 5

N.Q.1 - Quantities

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. N.Q.2 - Quantities

Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. N.VM.1 - Vector and Matrix Quantities

(+) 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). N.VM.3 - Vector and Matrix Quantities

(+) Solve problems involving velocity and other quantities that can be represented by vectors. A.CED.4 - Creating Equations

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. A.REI.3 - Reasoning with Equations and Inequalities

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. A.REI.4.b - Reasoning with Equations and Inequalities

Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b. F.IF.7.a - Interpreting Functions

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Graph linear and quadratic functions and show intercepts, maxima, and minima. G.GMD.3 - Geometric Measurement and Dimension

Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. G.GMD.4 - Geometric Measurement and Dimension

Identify the shapes of two-dimensional cross-sections of three- dimensional objects, and identify three-dimensional objects generated by rotations of two- dimensional objects. G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). G.MG.2 - Modeling with Geometry

Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). G.MG.3 - Modeling with Geometry

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).

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 6

A.CED.1 - Creating Equations

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. A.CED.2 - Creating Equations

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

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 7

N.Q.3 - Quantities

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. G.GMD.4 - Geometric Measurement and Dimension

Identify the shapes of two-dimensional cross-sections of three- dimensional objects, and identify three-dimensional objects generated by rotations of two- dimensional objects. G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). G.MG.3 - Modeling with Geometry

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).

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Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 8

A.SSE.1 - Seeing Structure in Expressions

Interpret expressions that represent a quantity in terms of its context. A.CED.1 - Creating Equations

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. A.CED.2 - Creating Equations

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.CED.3 - Creating Equations

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non- viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. A.REI.3 - Reasoning with Equations and Inequalities

Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. F.LE.5 - Linear, Quadratic, and Exponential Models

Interpret the parameters in a linear or exponential function in terms of a context. G.MG.1 - Modeling with Geometry

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

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 9

G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). G.MG.3 - Modeling with Geometry

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).

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Common Core State Standards for Mathematics

Unit 10

G.MG.1 - Modeling with Geometry

Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). G.MG.3 - Modeling with Geometry

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).

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 1

Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

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. Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 3

Science and Engineering Practice - Planning and Carrying Out Investigations

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. Science and Engineering Practice - Analyzing and Interpreting 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. Science and Engineering Practice - Analyzing and Interpreting Data

Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. Science and Engineering Practice - Analyzing and Interpreting Data

Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. Science and Engineering Practice - Analyzing and Interpreting Data

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. Science and Engineering Practice - Using Mathematics and Computational Thinking 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.) Science and Engineering Practice - Engaging in Argument from Evidence

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. Crosscutting Concepts - Systems and System Models

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PLTW Standards and Alignment

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.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 4

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS.ETS1.3 - Engineering Design

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. HS.ETS1.4 - Engineering Design

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. Science and Engineering Practice - Asking questions and defining problems

Ask questions

o that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

o that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

o to determine relationships, including quantitative relationships, between independent and dependent variables.

o to clarify and refine a model, an explanation, or an engineering problem. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Developing and Using Models

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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. Science and Engineering Practice - Developing and Using Models

Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems. Science and Engineering Practice - Planning and Carrying Out Investigations

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. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. Science and Engineering Practice - Planning and Carrying Out Investigations

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. Science and Engineering Practice - Analyzing and Interpreting 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. Science and Engineering Practice - Analyzing and Interpreting Data

Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. Science and Engineering Practice - Analyzing and Interpreting Data

Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. Science and Engineering Practice - Analyzing and Interpreting Data

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. Science and Engineering Practice - Using Mathematics and Computational Thinking

Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. Science and Engineering Practice - Using Mathematics and Computational Thinking

Apply techniques of algebra and functions to represent and solve scientific and engineering problems. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter- arguments based on data and evidence. Crosscutting Concepts - Scale, Proportion, and Quantity

Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). Crosscutting Concepts - Systems and System Models

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. Crosscutting Concepts - Structure and Function

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

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 5

Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Planning and Carrying Out Investigations

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. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. Science and Engineering Practice - Planning and Carrying Out Investigations

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. Science and Engineering Practice - Using Mathematics and Computational Thinking

Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. Science and Engineering Practice - Using Mathematics and Computational Thinking 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.) Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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). Crosscutting Concepts - Patterns

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

Mathematical representations are needed to identify some patterns. Crosscutting Concepts - Systems and System Models

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. Crosscutting Concepts - Structure and Function

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

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Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 6

Crosscutting Concepts - Structure and Function

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. Crosscutting Concepts - Structure and Function

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.

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Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 7

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS.ETS1.3 - Engineering Design

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. HS.ETS1.4 - Engineering Design

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. DCI - 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) DCI - 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) DCI - 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) Science and Engineering Practice - Asking questions and defining problems Evaluate a question to determine if it is testable and relevant. Science and Engineering Practice - Asking questions and defining problems

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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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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).

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Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 8

Science and Engineering Practice - Asking questions and defining problems

Ask questions

o that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

o that arise from examining models or a theory, to clarify and/or seek additional information and relationships.

o to determine relationships, including quantitative relationships, between independent and dependent variables.

o to clarify and refine a model, an explanation, or an engineering problem. Science and Engineering Practice - Asking questions and defining problems

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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Developing and Using Models

Develop a complex model that allows for manipulation and testing of a proposed process or system. Science and Engineering Practice - Analyzing and Interpreting Data

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. Science and Engineering Practice - Using Mathematics and Computational Thinking

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Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

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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). Crosscutting Concepts - Systems and System Models

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.

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Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 9

HS.ETS1.2 - Engineering Design

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS.ETS1.3 - Engineering Design

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. HS.ETS1.4 - Engineering Design

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. DCI - 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) DCI - 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) DCI - 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) DCI - ESS3.A - Earth and Human Activity - Natural Resources

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)

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

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4) Science and Engineering Practice - Asking questions and defining problems Evaluate a question to determine if it is testable and relevant. Science and Engineering Practice - Asking questions and defining problems

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. Science and Engineering Practice - Asking questions and defining problems

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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Constructing Explanations and Designing Solutions

Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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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. Science and Engineering Practice - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter- arguments based on data and evidence. Science and Engineering Practice - Engaging in Argument from Evidence

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). Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

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Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

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. Science and Engineering Practice - Obtaining, Evaluating, and Communicating Information

Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.

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Introduction to Engineering Design (IED)

Next Generation Science Standards

Unit 10

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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) DCI - 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) DCI - 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) Science and Engineering Practice - Asking questions and defining problems Evaluate a question to determine if it is testable and relevant. Science and Engineering Practice - Asking questions and defining problems

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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. Science and Engineering Practice - Developing and Using Models

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. Science and Engineering Practice - Constructing Explanations and Designing Solutions

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. Science and Engineering Practice - Engaging in Argument from Evidence

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. Science and Engineering Practice - Engaging in Argument from Evidence

Construct, use, and/or present an oral and written argument or counter- arguments based on data and evidence. Science and Engineering Practice - Engaging in Argument from Evidence

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).

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Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 1

1.9-12.L Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research. 2.9-12.Z Students will develop an understanding of the core concepts of technology. Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. 5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved.

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8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 10.9-12.I Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace. 10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

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R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 2

17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.
17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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PLTW Standards and Alignment

Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 3

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 2.9-12.DD Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process.

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9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means.

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17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 4

2.9-12.Z Students will develop an understanding of the core concepts of technology. Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

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K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Standards for Technological Literacy

Unit 5

2.9-12.Z Students will develop an understanding of the core concepts of technology. Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

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K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Standards for Technological Literacy

Unit 6

12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Standards for Technological Literacy

Unit 7

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

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K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 8

8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

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O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 9

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 4.9-12.H Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. 4.9-12.I Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. 4.9-12.J Students will develop an understanding of the cultural, social, economic, and political effects of technology.

J. Ethical considerations are important in the development, selection, and use of technologies. 5.9-12.L Students will develop an understanding of the cultural, social, economic, and political effects of technology.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring

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possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.I Students will develop an understanding of the attributes of design.

I. Design problems are seldom presented in a clearly defined form. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 10.9-12.J Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved. 11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

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P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 13.9-12.K Students will develop the abilities to assess the impact of products and systems.

K. Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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Introduction to Engineering Design (IED)

Standards for Technological Literacy

Unit 10

2.9-12.Z Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. 2.9-12.AA Students will develop an understanding of the core concepts of technology. AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. 2.9-12.BB Students will develop an understanding of the core concepts of technology.

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. 8.9-12.H Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. 8.9-12.J Students will develop an understanding of the attributes of design.

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. 8.9-12.K Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. 9.9-12.I Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. 9.9-12.J Students will develop an understanding of engineering design.

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. 9.9-12.K Students will develop an understanding of engineering design.

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K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. 9.9-12.L Students will develop an understanding of engineering design.

L. The process of engineering design takes into account a number of factors. 11.9-12.M Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it. 11.9-12.N Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. 11.9-12.O Students will develop the abilities to apply the design process.

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. 11.9-12.P Students will develop the abilities to apply the design process.

P. Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note areas where improvements are needed. 11.9-12.Q Students will develop the abilities to apply the design process.

Q. Develop and produce a product or system using a design process. 11.9-12.R Students will develop the abilities to apply the design process.

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. 12.9-12.L Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. 12.9-12.P Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. 17.9-12.P Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. 17.9-12.Q Students will develop an understanding of and be able to select and use information and communication technologies.

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Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli.

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PLTW Standards and Alignment

Exhibit B

Course Outline:

Unit 1: History of Engineering and Design

Students will understand that design is a visual art. They will utilize a variety of techniques to "read" and "study" products, the stories they have to tell, the people who built them, and those who use them. Students will learn the characteristics that identify a certain product and its manufacturing process. They will understand that not all products are created equal and that design solutions are as diverse as its multicultural society and has been shaped by many internal and external factors and regional distinctions. Students will investigate historical drawings, carvings that lead to design innovation. Finally, students will present a research project on the history of a product that they own or that they admire.

Unit 2: Design Process

The goal of Unit 2 is to introduce students to the broad field of the design process and design thinking as applied to both engineering and design whereby those professionals use it to develop innovative solutions to real problems. Students become familiar with the traditional big four disciplines of engineering and the extensive array of career opportunities and engineering problems addressed within each discipline. A design process is presented as a structured method for approaching and developing solutions to a problem or needs of a client. The art and skill of brainstorming is emphasized as students begin to develop skill in graphically representing ideas through concept sketching. A variety of design challenges will be completed throughout this unit to familiarize students with the cyclical nature of the design process.

Unit 3: Technical Sketching and Drawing

The goal of Unit 3 is for students to develop an understanding of the purpose and practice of visual representations and communication within design and engineering in the form of technical sketching and drawing. This in depth unit will give students skills in orthographic projection, dimensioning, perspective drawing, two point perspective drawing, and 2D and 3D hand drawn representations. These drawing skills will be utilized throughout the year as students build skill and gain experience in representing three-dimensional objects in two dimensions. Students will create various technical representations used in visualization, exploring, communicating, and documenting design ideas throughout the design process, and they will understand the appropriate use of specific drawing views (including isometric, oblique, perspective, and orthographic projections). They progress from creating freehand technical sketches using a pencil and paper to developing CAD drawings according to

accepted standards and practices that allow for universal interpretation of their design.

Unit 4: User Centered Design

This unit of study introduces students to standard practice in the design of single family homes and provides an opportunity for students to develop single family home design that incorporates sustainable design practices as well as universal design features. Students will both hand draw blueprints, design elements and exterior elevations as well as use CAD software to show their design. Students will also furnish and decorate their home according to client wants/ needs demonstrating knowledge of current trends in interior design and landscape design. Students will be introduced to building codes and their impact on design as well as common wood-framed residential construction techniques and practices. Students will also investigate the cost of construction and the significant impact of the choice of construction materials and practices on the operating cost of energy for heating and cooling. They will apply this knowledge to the design of a single family residential home and show how it is designed with the user in mind.

Unit 5: Measurement and Statistics

The goal of Unit 5 is for students to become familiar with appropriate practices and the applications of measurement (using both U. S. Customary, and SI units). Students will understand that designers create blueprints using scale measurements. Accurate dimensions are critical for drawings to have any meaning. There are many standards that govern the placement of dimensions in a drawing. Students are assigned the task of adding and correctly placing dimensions to their drawings. Students will use ANSI Y14.5 standards for their blueprints. From the lectures and discussions, they will understand that dimensions show 2 things: location and size.

Unit 6: Modeling through Products

This unit introduces students to a variety of modeling methods and formats used to create everyday products. They will use the array of CAD tools to generate a solid model from a 2D sketch. They will learn extrusions, revolves, sweeps, patterns, fillets, chamfers and many more tools to generate their models. They will also learn to work with assemblies and components to combine parts and models. Students are provided the opportunity to create a physical model of a design solution to be used for testing purposes. Mathematical modeling is introduced, and students learn to find mathematical representations (in the form of linear functions) to represent relationships discovered during the testing phase of the design process.

Unit 7: Reverse Engineering

Unit 7 exposes students to the application of engineering principles and practices to reverse engineer a consumer product. Reverse engineering involves disassembling and analyzing a product or system in order to understand and document the visual, functional, and/or structural aspects of its design. In this unit students will have the opportunity to assess all three aspects of a product's design. Students will learn the visual design elements and principles and their application in design. They will perform a functional analysis to hypothesize the overall function and sequential operations of the product's component parts and assess the inputs and outputs of the process(es) involved in the operation of the product. Students will physically disassemble the product to document the constituent parts, their properties, and their interaction and operation. After carefully documenting these aspects of the visual, functional, and structural aspects of the product, students will assess the strengths and weaknesses of the product and the manufacturing process by which it was produced. Technical sketching and drawing both by hand and using CAD software will be used to document all parts of the reverse engineering process. It will also be a tool for students to make changes, sowing innovation, with the object being investigated.

Unit 8: Alternative Energy and Green Design

Students will understand that green design, is an approach to building that minimizes harmful effects on human health and the environment. The "green" architect or designer attempts to safeguard air, water, and earth by choosing eco-friendly building materials and construction practices. Students will be able to identify environmental impact that products and buildings have on our life. Students will investigate how buildings and products attain sustainable certifications. In this unit students will also discover the various types of alternative energies currently being used throughout the world. They will compares the pros and cons of each type, as well as understand how the energy is produced and distributed. Students will redesign a product that can be improved on its impact on our planet by using sustainable strategies. Students will learn Ecological design tools used by professionals to test their impact on our planet. Students will draw various designs into CAD and 3-D print a scale model of their final solution.