

## Statewide Framework Document for:

### **460000 Core Plus - Construction**

Standards may be added to this document prior to submission but may not be removed from the framework to meet state credit equivalency requirements. Performance assessments may be developed at the local level. In order to earn state approval, performance assessments must be submitted within this framework. **This course is eligible for 3<sup>rd</sup> Credit of Math, Science and English Language Arts.**

The Washington State Science Standards performance expectations for high school blend core ideas (Disciplinary Core Ideas, or DCIs) with scientific and engineering practices (SEPs) and crosscutting concepts (CCCs) to support students in developing usable knowledge that can be applied across the science disciplines. These courses are to be taught in a [three-dimensional manner](#). The details about each performance expectation can be found at [Next Generation Science Standards](#), and the supporting evidence statements can be found under [Resources](#).

Washington Mathematics Standards (Common Core State Standards) support foundational mathematical knowledge and reasoning. While it is important to develop a conceptual understanding of mathematical topics and fluency in numeracy and procedural skills, teachers should also focus on the application of mathematics to career fields to support the three (3) key shifts of CCSS. The Standards for Mathematical Practice develop mathematical habits of mind and are to be modeled and integrated throughout the course. The details about each mathematical standard can be found at [Common Core Mathematics Standards](#).

Washington English Language Arts Standards (Common Core State Standards) establish guidelines for literacy in history/social studies, science, and technical subjects. The College and Career Readiness Anchor Standards form the backbone of the ELA/literacy standards by articulating core knowledge and skills, while grade-specific standards provide additional specificity. The details about English Language Arts Standards can be found at [Common Core English Language Arts Standards](#).

School District Name	
<b>Course Title:</b> Core Plus Construction	<b>Total Framework Hours:</b> 540 hours
<b>CIP Code:</b> 460000 <input type="checkbox"/> <b>Exploratory</b> <input checked="" type="checkbox"/> <b>Preparatory</b>	<b>Date Last Modified:</b> February 15, 2020
<b>Career Cluster:</b> Construction	<b>Cluster Pathway:</b> Construction
<b>Course Summary:</b> 89% of General Contractors in Washington State report difficulty filling high wage jobs in the construction industry. Core Plus Construction will provide Washington State high school students with the knowledge, skills, and abilities to pursue construction careers that provide rewarding careers with excellent wages and benefits while receiving credit equivalencies for high school graduation requirements.	
<b>Eligible for Equivalent Credit in:</b> 3 <sup>rd</sup> Credit of Math, Science and ELA	<b>Total Number of Units:</b> 16
<b>Course Resources:</b> Core Plus: <a href="https://core-plus.org/">https://core-plus.org/</a>	

**Unit 1: Introduction to Construction****Total Learning Hours for Unit: 15**

**Unit Summary:** Students will gain an understanding of the history of construction, contemporary construction practices and an overview of Construction management. This unit will also introduce the anatomy of a building, phases of construction and the various careers available in the construction industry.

**Performance Assessments:** *These can be locally developed or use the suggested assessments below.*

Assessments will be summative and formative, written, verbal and practical. Students will be able to:

**General**

- Explain and demonstrate knowledge of the historical roots of construction and contemporary construction projects.
- Observation of correct applications of historical and contemporary construction projects concepts in the performance classroom activities.
- Demonstrate through written tasks and examinations the concepts of historical and contemporary construction projects.
- Work in groups to apply concepts of historical and contemporary construction projects in instructional activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations on historical and contemporary construction projects.

**English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Conduct short research project to analyze and argue the social value versus costs of a "Local Wonder" of construction by synthesizing multiple sources on the subject, and presenting the information, findings and supporting evidence such that listeners can follow the line of reasoning.
- Utilize an interactive dashboard of state-wide construction statistics pertaining to roles, salaries, education tracks, etc., to gather evidence via in building employment profiles for key construction roles. Reports will reflect organization, development, and style that are appropriate to task, purpose and audience.
- Make regular oral presentations related to construction topics (e.g., safety, status briefings) or occupational requirements (e.g., leading teams, writing a memo, communicating by letter) adapting speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

**Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- 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.
- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

**Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Perform measurement and layout activities for simple construction projects. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.
- Conduct a short research project to evaluate statistical data sets related to safety accidents, frequencies, and causes. Organize the results to ensure comprehension by target audience, and present findings using digital media to display results.
- Calculate organizational productivity as a function of revenue, labor/effort, and efficiency. Plot various productivity rates over time.

#### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students.

Suggested skills include:

Students will work collaboratively in small groups to complete projects that will require them to design, schedule and execute a work plan using prints to complete assignments and projects

Students will be assigned rotating leadership roles in the group that will make them responsible for specific outcomes of the project

Student will present to class on career research as well as personal interest in the construction industry to class

Students will provide constructive feedback to one another regarding presentations and group work interaction

Students will provide guidance and feedback to fellow work group members and classmates through peer evaluations

Students will consider their own knowledge, skills and abilities through self-evaluations

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others ( 1.B.2)
- Reason Effectively (2.A.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

#### **Industry Standards and/or Competencies:**

Student will be able to:

- Describe the essential elements of the Built Environment and their necessity in successful contemporary construction practice.
- Identify common traits from early civilizations
- Identify and describe the Seven Wonders of the World
- Identify, research, and present to their peers a local "wonder" in their community.
- Orally and in writing, describe types and key aspects of construction projects
- Explain construction project roles, their responsibilities, and their interdependencies.

- Conduct a short research project to answer a question or solve a problem, organize the results to ensure comprehension by target audience, and present findings using digital media to display results.
- Describe the primary features distinguishing historic construction from contemporary construction
- Explain the critical function of construction management including cost management, schedule, budget, prints/drawings, quality, safety, compliance, communications and technology.
- Describe the fundamental components in the anatomy of a building.
- Explain the phases of construction and why they are sequenced as they are.

### Aligned Washington State Academic Standards

#### English Language Arts: Common Core

##### ANCHOR STANDARDS

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>

CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.

CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

READING INFORMATIONAL TEXTS

RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RI.11-12.2 - Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.

WRITING

W.11-12.1.D - Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11-12.2.B - Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)

SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

LANGUAGE

L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (includes L.11-12.1.B)

L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (includes L.11-12.2.A/B )

L.11-12.4.D Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

HISTORY/SOCIAL STUDIES

RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.

	SCIENCE AND TECHNICAL SUBJECTS RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	
Mathematics: Common Core	HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. HS.S.IC.6 Evaluate reports based on data.	
Mathematical Practices	MP 1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively. MP3 Construct viable arguments and critique the reasoning of others. MP4 Model with mathematics. MP5 Use appropriate tools strategically.	
Science	HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Systems and System Models
Using Mathematics and Computational Thinking	ESS3.C Human Impacts on Earth Systems	Energy and Matter

Analyzing and Interpreting Data		
Obtaining, Evaluation, and Communicating Information		

## Unit 2: Materials Science

**Total Learning Hours for Unit:** 140

**Unit Summary:** Through hands-on demonstrations, experiments, and projects, students will develop necessary critical thinking skills to evaluate and apply appropriate material choices for various types of construction projects in relation to the environments they are being built in.

**Performance Assessments:** *These can be locally developed or use the suggested assessments below.*

Assessments will be summative and formative, written, verbal and practical. Students will be able to:

### **General**

- Explain and demonstrate knowledge of materials science concepts of as they relate to construction activities.
- Observation of correct and accurate applications of materials science concepts in the performance of practical construction activities in the classroom and shop.
- Demonstrate through written tasks and examinations the concepts and skills in using materials science related to construction operations.
- Work in groups to apply materials science principles in practical construction activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of materials science solutions to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Create material profiles for three common and critical construction materials reporting on applications, structural strength, composition, relative cost, transportation, and availability.
- For a given construction application (e.g., wall finishing), create a presentation that analyzes the advantages/disadvantages of three competing materials available for that purpose.
- Write an installation procedure for a selected construction material noting installation techniques, tools and equipment required, fastening approach, and safety procedures that must be observed.
- Conduct a safety meeting with your project team and present a hazard analysis of the materials you will be working with that week.
- Select a construction material that fosters sustainable construction principles and argue for its use in a building project.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- 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.
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

- Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Perform measurement and layout activities for simple construction projects. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.
- Develop cost models for construction budgets based on material quantities and structure size.
- Examine various options of building materials and draw conclusions from graphical data on material performance, suitability, and sustainability.
- Calculate the density and bearing capacities of several soil and fill materials. Given building specifications, determine which materials are suitable for foundation support on the project.
- Using construction drawings, to determine material quantities, convert units of measure, place orders, schedule deliveries, and construct budgets.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will reflect upon their own actions and decisions through self-evaluations on assigned projects

Students will practice professional communication and behavior through peer evaluations on assigned projects

Students will develop the ability to lead and guide others by serving as peer project guides and elbow partners

Students will recognize their role in the health and well being of all members of the class

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Material Science, Construction Materials, and History**

- Define materials science and how it has changed through history
- Explain the importance of materials sciences.
- Identify construction materials



- List several common materials used in the design and construction of structures.
- Define simple properties of materials, such as strength, flexibility, transparency.
- Select suitable materials for making a particular object based on their properties.
- Explain the advantages and disadvantages of common materials used in engineering structures.

### **Classification of Matter**

- Classify matter
- Summarize the spatial relationships found on the Periodic Table of Elements
- Define types of structure, crystalline vs. amorphous
- Apply basic chemistry to explain physical and chemical characteristics of the four categories of materials.
- Apply knowledge of materials science to explain materials choices in design.
- Use critical thinking to evaluate and apply appropriate materials choice for specific applications.

### **Bonding**

- Define types of bonding.
- Identify types of properties
- Relate properties to types of bonding

### **Physical and Mechanical Properties of Material Science**

- Distinguish between chemical and physical properties of a material.
- Differentiate between oxidation and reduction especially as they pertain to galvanic corrosion.
- Define thermal expansion.
- Evaluate the effects of thermal expansion on design considerations.
- Describe the response to force or stress using the terms: workability (malleability and ductility), brittleness, hardness, elasticity and plasticity, toughness and strength.
- Define mechanical properties: tensile strength, compression, fatigue, flexure, impact, torsion, hardness, and shear.
- Relate the physical characteristics of materials such as workability and brittleness to the mechanical properties such as tensile and compressive strength to impact design considerations.

### **Aligned Washington State Academic Standards**

<b>English Language Arts: Common Core</b>	<p><u>ANCHOR STANDARDS</u></p> <p>CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p> <p>CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup></p> <p>CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.</p>
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CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.

CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2 )

W.11-12.3.E Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative. (WHST.11-12.3 )

W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4 )

- W.11-12.5 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. (WHST.11-12.5)
- W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )
- W.11-12.7. 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. (WHST.11-12.7)
- W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (WHST.11-12.8 )
- W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (WHST.11-12.9)

#### SPEAKING AND LISTENING

- SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)
- SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
- SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (
- SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

#### LANGUAGE

- L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

	<p>L.11-12.4.D. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>HS.F.IF.6 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.*</p> <p>HS.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*</p> <p>HS.F.IF.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima.</p>

HS.F.IF.7.C Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

HS.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

HS.G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

HS.G.CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

HS.G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

HS.G.CO.6v Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

HS.G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:

HS.G.SRT.1.A A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

HS.G.SRT.1.B The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

HS.G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

HS.G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

HS.G.C.1 Prove that all circles are similar.

HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

HS.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically

HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

	<p>HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.</p> <p>HS.S.ID.6.A 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.</p> <p>HS.S.ID.6.B Informally assess the fit of a function by plotting and analyzing residuals.</p> <p>HS.S.ID.6.C Fit a linear function for a scatter plot that suggests a linear association.</p> <p>HS.S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p> <p>MP7 Look for and make use of structure.</p> <p>MP8 Look for and express regularity in repeated reasoning.</p>
<b>Science</b>	<p>HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</p> <p>HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</p> <p>HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</p> <p>HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</p>

	<p>HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p>HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*</p> <p>HS-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</p> <p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Systems and System Models
Developing and Using Models	ETS1.C: Optimizing the Design Solution	Energy and Matter
Using Mathematics and Computational Thinking	PS1.A Structure and Properties of Matter PS1.B Chemical Reactions	Stability and Change
Planning and Carrying Out Investigations	PS2.B Types of Interactions	Structure and Function
Analyzing and Interpreting Data	PS3.A. Definitions of Energy	
Obtaining, Evaluating, and Communicating information	ESS3.C Human Impacts on Earth Systems	

<b>Unit 3:</b> Construction Tools	<b>Total Learning Hours for Unit:</b> 25
<b>Unit Summary:</b> Introduction to a variety of hand tools, portable power tools, and stationary equipment; students will become familiar with safety considerations for their correct use, features, distinguishing characteristics, normal operating techniques, and the applications for which they are commonly applied.	

**Performance Assessments:** *These can be locally developed or use the suggested assessments below.*

Assessments will be summative and formative, written, verbal and practical. Students will be able to:

### **General**

- Explain and demonstrate knowledge of hand tools, power tools, and stationary equipment concepts of as they relate to construction activities.
- Observation of correct and safe applications of hand tools, power tools, and stationary equipment concepts in the performance of practical construction activities in the classroom and shop.
- Explain and demonstrate safety practices related to tool operation, maintenance, and storage.
- Demonstrate through written tasks and examinations the concepts and skills in using hand tools, power tools, and stationary equipment related to construction operations.
- Work in groups to safely use hand tools, power tools, and stationary equipment in practical construction activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of hand tools, power tools, and stationary equipment as solutions to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Synthesize information from commonly available textual sources and then compose Operator's Manual for three construction tools. Examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline for this written product.
- Develop a persuasive presentation in the form of a "company policy" on the safe operation of a power tool. The policy will fully evaluate the costs/benefits of the practice and concisely state in formal English the protocols set by the policy. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Evaluate peer written products and presentations' point of view, reasoning, and use of evidence/rhetoric when establishing position, premises, or procedure. Analyze the effectiveness of the author's structure, argument, and use of supporting evidence. Provide a written response that fairly and thoroughly addresses the strengths and weaknesses of the author's claims.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- Evaluate competing design solutions 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.
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Perform measurement and layout activities for simple construction projects. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.



- For given specifications, calculate and compare productivity between several type or tools and techniques. Provide data to support recommendations on how to conduct the project.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work in small groups, with partners and as individuals to complete assignments and projects

Students will lead and guide others as they develop and apply knowledge skills and abilities

Student will present to class on proper tool usage and general safety topics

Students will provide constructive feedback to one another regarding tool usage and general safety topics presentations

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

Solve Problems (1.1.2, D.1, 2.D.2)

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

#### **Lesson 1: General Tool Safety:**

- Explain personal choices that reduce the risk of safety hazards.
- Name and properly don personal protective equipment for the use of basic construction tools.
- Identify common hazards associated with tool use.
- Describe the importance of tool inspection and care in preventing injuries.
- Discuss how the ergonomics of tools use prevents injuries.

#### **Hand Tools Identification and Application:**

- Identify key features and explain the application of each hand tool for particular workplace tasks.
- Demonstrate the safe operation of hand tools.
- Perform competent operation of hand tools in their intended use.
- Properly choose and consistently wear proper PPE for hand tool use.
- Describe proper maintenance and care for each hand tool.
- Operate hand tools in practice skill building activities
- Perform a small-scale construction project or activity

- Students will create “User’s Manuals” for three hand tools.

#### **Hand Power Tools Identification and Applications:**

- Identify basic maintenance that should be done.
- List proper techniques for loading and activating the nail gun
- Describe and select the appropriate nail gun to accomplish a particular workplace task.
- Distinguish between nail guns that are similar in appearance, stating the commonly used terms for each tool and normal routine application.
- Explain basic techniques and proper use of nail guns.
- List workplace tasks or functions that require a nail gun to accomplish the task.
- Specify the features and major components.
- Operate hand tools in practice skill building activities
- Perform a small-scale construction project or activity individually and with teammates.
- Students will create “User’s Manuals” for three power tools.

#### **Stationary Equipment Identification and Applications:**

- Identify key features and explain the application of each piece of equipment. 10.29.18
- Demonstrate the safe operation of the stationary equipment.
- Perform competent operation of stationary tools in their intended use.
- Properly choose and consistently wear proper PPE for equipment use.
- Describe proper maintenance and care for each piece of stationary equipment.

#### **Aligned Washington State Academic Standards**

<b>English Language Arts: Common Core</b>	<p><u>ANCHOR STANDARDS</u></p> <p>CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p> <p>CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup></p> <p>CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.</p> <p>CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.</p> <p>CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.</p>
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- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

- W.11-12.1.D Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- W.11-12.2.A Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- W.11-12.5 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.
- W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

#### SPEAKING AND LISTENING

	<p>SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.</p> <p>SL.11-12.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (includes L.11-12.1.B)</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (includes L.11-12.2.A/B)</p> <p>L.11-12.4.C Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, its etymology, or its standard usage.</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<b>Mathematics: Common Core</b>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p>

	<p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p>	
<b>Mathematical Practices</b>	<p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>	
<b>Science</b>	<p>HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</p> <p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p>	
<b>Science and Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Cause and Effect
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Stability and Change
Using Mathematics and Computational Thinking	ETS1.C: Optimizing the Design Solution	
Analyzing and Interpreting Data	PS2.A Forces in Motion	
Obtaining, Evaluating, and Communicating information	ESS3.C Human Impacts on Earth Systems	

<b>Unit 4: Construction Safety</b>	<b>Total Learning Hours for Unit: 35</b>
<p><b>Unit Summary:</b> This unit provides a general overview of construction safety and in-depth specific environment, health, and safety issues, policies, procedures, and regulations that are relevant to construction industry.</p>	
<p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p>	
<p><b><u>General</u></b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of safety concepts of as they relate to construction activities.</li> <li>• Observation of correct and accurate applications of safety concepts in the performance of practical construction activities in the classroom and shop.</li> <li>• Demonstrate through written tasks and examinations the concepts and skills in using safety related to construction operations.</li> <li>• Work in groups to apply safety principles in practical construction activities.</li> <li>• Use technology-based tools, printed documentation, and other media sources to research and make presentations of safety solutions to practical construction related activities.</li> </ul>	
<p><b><u>English/Language Arts</u></b></p> <p>Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:</p> <ul style="list-style-type: none"> <li>• Conduct regular safety meetings on topics from "Tool Box Talks" with the project team and present a hazard analysis of the work that will be performed that week.</li> <li>• Develop an audit protocol that can be used to assess potential hazards in your shop.</li> <li>• Compose a safety plan for a construction site that meets the standard OSHA format.</li> </ul>	
<p><b><u>Science</u></b></p> <ul style="list-style-type: none"> <li>• Analyze complex real-world problems by specifying criteria and constraints for successful solutions.</li> <li>• Evaluate competing design solutions 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.</li> <li>• Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</li> <li>• Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).</li> </ul>	
<p><b><u>Mathematics</u></b></p> <p>Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:</p> <ul style="list-style-type: none"> <li>• Conduct a short research project to evaluate statistical data sets related to safety accidents, frequencies, and causes. Organize the results to ensure comprehension by target audience, and present findings using digital media to display results.</li> <li>• Determine the impact of personal protective equipment on productivity by conducting performance studies and compiling data.</li> <li>• Compose an excavation safety plan by calculating the appropriate slope dimensions to prevent collapse and ensure safety.</li> </ul>	
<b>Leadership Alignment:</b>	

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work in small groups, on teams, with partners and as individuals to complete safety assignments

Students will reflect on their decisions and actions through self-evaluations as related to work products and behavior in the shop/lab setting

Students will rotate through various roles in their project groups which will require them to be responsible for the safety and wellbeing of their team

Students are empowered and expected to enforce all safety procedures in the shop/lab setting

Students will serve as peer evaluators and guides on basic skill development assignments

Student will present to class on proper tool usage and general safety topics

Students will provide constructive feedback to one another regarding tool usage and general safety topics presentations

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.2, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **History of Construction Safety**

- Describe the major developments that have influenced and improved construction safety over time.
- Learn how to research and interpret the current construction accident data
- Define personal protective equipment
- Identify and explain reasons for PPE

#### **General Construction Safety**

- Explain the purpose and organization of OSHA and use the 29 CFR 1926 to research and identify applicable safety regulations
- Perform Hazard identification, site inspections, and hazard communication particularly related to:
  - Focus Four Hazards
  - Fire hazards
- Explain the concept of Hazard mitigation and prepare written plans and procedures that address:
  - Safety Plans and Shop Safety
  - Proper use of PPE

- Material handling, communication, and safety data sheets
- Ergonomics
- First aid and safety equipment
- Drug-free workplace

### **The Focus-Four Hazards**

- Explain the meaning of the Focus Four hazards: fall, electrical, struck-by, caught-in/between
- Define the critical role of safety with fall hazards
- Define the critical role of safety with electrical hazards
- Define the critical role of safety with struck-by hazards
- Define the critical role of safety with caught-in/between hazards

### **Aligned Washington State Academic Standards**

#### **English Language Arts: Common Core**

#### ANCHOR STANDARDS

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>

CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.

CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.



CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

READING INFORMATIONAL TEXTS

RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.

RI.11-12.2 - Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.

WRITING

W.11-12.1.D - Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11-12.2.B - Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)

SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (

LANGUAGE

L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. (includes L.11-12.1.B)

L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing. (includes L.11-12.2.A/B )

	<p>L.11-12.4.D Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).</p> <p><u>HISTORY/SOCIAL STUDIES</u></p> <p>RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.</p> <p>RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<b>Mathematics: Common Core</b>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p>

	MP6 Attend to precision.	
<b>Science</b>	<p>HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</p> <p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Systems and System Models
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Cause and Effect
Using Mathematics and Computational Thinking	ESS3.C Human Impacts on Earth Systems	
Analyzing and Interpreting Data	PS2.A Forces in Motion	
Obtaining, Evaluating, and Communicating Information		

<b>Unit 5:</b> Construction Measurement	<b>Total Learning Hours for Unit:</b> 20
<b>Unit Summary:</b> The lesson includes hands-on practice with a variety of common and precision measurement tools, instruction includes the review of geometric dimensioning and tolerances, and the use, care and calibration of precision measurement tools.	
<b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i> Assessments will be summative and formative, written, verbal and practical. Students will be able to:	
<b>General</b> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of the concepts of fractions as they relate to measurement.</li> <li>• Observation of correct and accurate measurement technique using standard construction measuring tools and equipment during classroom and shop activities.</li> <li>• Describe the differences between measuring by fractions and decimals.</li> <li>• Demonstrate through written examination general knowledge of measuring and mathematics related to measuring.</li> </ul>	

- Work in groups to apply measurement principles in practical construction activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of measurement techniques to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Reading construction prints and drawings to translate dimensions and decode symbols into correct scaled measurement projects.
- Translate the results of estimating materials needed for a project into a purchase order request.
- Given a set of specifications, create a drawing of the product with proper dimensions, symbols, and both an orthographic and isometric views.

### **Science**

- Use mathematical representations of phenomena to describe explanations.
- Create a computational model or simulation of a phenomenon, designed device, process, or system.
- 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.
- 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.
- Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Perform measurement and layout activities for simple construction projects. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.
- Using construction drawings, to determine material quantities, convert units of measure, place orders, schedule deliveries, and construct budgets.
- Develop cost models for construction budgets based on material quantities and structure size.
- Calculate amounts of materials needed by linear and volumetric dimensions then determine costs and impact to budget.
- Consistently and accurately convert measurement values between imperial and metric units and decimals when calculating values in construction practices.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work in small groups, with partners and as individuals to complete assignments and projects

Students will lead and guide others as they develop and apply knowledge skills and abilities

Students will reflect on their decisions, actions, and skill development through self-evaluations on assigned projects

Students will work together as peer evaluators to provide constructive feedback on skill improvement

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Measuring**

- Use a standard rule, metric ruler, and measuring tape and read to the 1/16<sup>th</sup> inch to measure lengths
- Explain what the metric system is and how it is important to the construction industry
- Add, subtract, divide, and multiply fractions
- Add, subtract, divide, and multiply decimals
- Convert fractions to decimals and decimals to fractions.
- Convert decimals to feet and inches
- Measure dimension Strings and Grids
- Calculate area, perimeter, surface area and volume

#### **Measuring Tools**

- Measuring tape
- Framing square
- Speed square
- Simple combination square
- Straight edges
- Measuring wheel
- Builder's level
- Surveying equipment

#### **Level and Plumb**

- Determine vertical plumb using measurement, builder levels, and laser levels
- Determine horizontal level using measurement, builder levels, and laser levels

#### **Miscellaneous Measurements**

- Calculate crane radius calculations
- Determine arcs of pipe bends for electrical conduit

- Measure large scale dimensions and grades using string measure, laser level, surveying equipment.

## Aligned Washington State Academic Standards

### English Language Arts: Common Core

#### ANCHOR STANDARDS

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>

CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.

CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.

CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

	<p><u>WRITING</u></p> <p>W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)</p> <p>W.11-12.5 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. (WHST.11-12.5)</p> <p>W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.</p> <p>HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p> <p>HS.G.C.1 Prove that all circles are similar.</p>

	<p>HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</p> <p>HS.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically</p> <p>HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p> <p>HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</p> <p>HS.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*</p> <p>HS.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*</p> <p>HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p>	
Mathematical Practices	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>	
Science	<p>HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</p> <p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept



Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Systems and System Models
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Cause and Effect
Using Mathematics and Computational Thinking	ESS3.C Human Impacts on Earth Systems	Patterns
Analyzing and Interpreting Data		
Obtaining, Evaluating, and Communicating Information		

Unit 6: Introduction to Drawings, Print Reading, and Layout	Total Learning Hours for Unit: 40
<p><b>Unit Summary:</b> In this unit, students are introduced to basic blueprint reading and how to interpret engineer drawings; students will get hands-on experience drawing isometric and orthographic views, and constructing projects from sketches and prints.</p> <p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of the concepts of fractions as they relate to measurement and scale.</li> <li>• Observation of correct and accurate print reading technique using standard architectural nomenclature and symbology during classroom and shop activities.</li> <li>• Describe the different sections in a set of standard construction prints.</li> <li>• Demonstrate through written examination general knowledge of print reading, and measuring and mathematics related to construction print scale.</li> <li>• Work in groups to apply print reading principles in practical construction activities.</li> <li>• Use technology-based tools, printed documentation, and other media sources to research and make presentations of print reading techniques to practical construction related activities.</li> </ul> <p><b>English/Language Arts</b></p> <p>Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:</p> <ul style="list-style-type: none"> <li>• Translate a simple construction drawing from its symbolic and dimensional representation into a written description the presents the form and function of each element.</li> <li>• Given a set of specifications, sketch a representation using correct symbols and dimensions, then present your project to the class.</li> <li>• Given a drawing, correctly prepare a Request for Information (RFI) that accurately describes the problem and the specifics of the information being sought.</li> <li>• Select 8 construction drawing symbols, define them, and present to the class.</li> <li>• Compare the uses of and elements on a framing isometric drawing to those of a framing plan.</li> </ul>	

## **Science**

- Use mathematical representations of phenomena to describe explanations.
- Create a computational model or simulation of a phenomenon, designed device, process, or system.
- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

## **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Comprehend and apply the concept of scale when reading construction drawings and prints, and when designing shop projects.
- Perform measurement and layout activities for simple construction projects. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.
- Using construction drawings, to determine material quantities, convert units of measure, place orders, schedule deliveries, and construct budgets.
- Consistently and accurately convert measurement values between imperial and metric units and decimals when calculating values in construction practices.
- Apply the Pythagorean Theorem to determine and verify square and plumb layout.
- Use basic trigonometry to determine roof slope (ratio of rise to run) and calculate roof area. Translate these dimensions into a quantity and complete a purchase order for the required material.

## **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will demonstrate their ability to interpret prints while assisting others as they develop their skill set

Students will work in small groups, with partners and as individuals to complete assignments and projects from supplied prints

Students will demonstrate professional communication and behavior by acting as peer evaluators on assigned projects

Students will reflect on their decisions and skill development through self-evaluations on assigned projects

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.2, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)

- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1, includes all sub-listings)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

#### **History of construction drawings and print documents; why are they used**

- Describe historic construction drawings/print tools and documents

#### **Sections of Construction Prints**

- Locate the Title Block on a drawing and identify the name, purpose of a drawing, and other fields depicted.
- Interpret geometric elements in a drawing.
- Identify the Alphabet of Lines.
- Identify types of views, including detail views, sectional views, auxiliary views, and be able to interpret cutting lines.
- Interpret common drawing symbols used in industry.
- Identify types of dimensioning: linear, progressive, typical, equally spaced, angles, arcs, cylinders, holes, size, location, baseline, and tabular.
- Recognize different types of construction prints/drawings.
- Explain the different sections in a set of drawings
- Describe the details, symbols, and nomenclature in each section

#### **Reading Print/Drawings**

- Identify lines, symbols, abbreviations, and nomenclature within prints
- Explain the difference and significance between plan view and elevations
- Explain scale and the mathematical concepts supporting it
- Demonstrate correct interpretation of drawing/print information and specifications to the correct location on the plan.
- Perform necessary mathematics to determine scale and measurements
- Specifications
- Components of the drawings: Title block, Border, Drawing area, Revision block, Legend
- Orthographic and Isometric views

#### **Construction Specifications**

- Explain the purpose of specifications in construction projects
- Describe how specifications and construction drawings are used together on construction projects
- Elaborate on the purpose and function of the Construction Specifications Institute (CSI)
- Articulate what a "division" is in construction specifications and name the common divisions.

#### **Layout**

- Demonstrate how to layout the foundation of a project
- Translate drawing information into operational plans

**English Language Arts: Common Core**

ANCHOR STANDARDS

- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

READING INFORMATIONAL TEXTS

- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

WRITING

- W.11-12.1.D Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

	<p>W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)</p> <p>W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)</p> <p>W.11-12.5 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. (WHST.11-12.5.)</p> <p><u>SPEAKING AND LISTENING</u></p> <p>SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, C, and D)</p> <p>SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>

	<p>HS.G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.</p> <p>HS.G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</p> <p>HS.G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.</p> <p>HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.</p> <p>HS. G.SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*</p> <p>HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p> <p>HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</p> <p>HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p> <p>HS.G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p> <p>MP7 Look for and make use of structure.</p>
<b>Science</b>	<p>HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.</p> <p>HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>

	HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Energy and Matter
Developing and Using Models	ETS1.C: Optimizing the Design Solution	Systems and System Models
Using Mathematics and Computational Thinking	ESS3.A Natural Resources	Cause and Effect
Obtaining, Evaluating, and Communicating Information	ESS3.C Human Impacts on Earth Systems	

Unit 7: Construction Math	Total Learning Hours for Unit: 40
<b>Unit Summary:</b> This unit is project-based and requires students to work together practicing the designing, building and testing of a model footbridge, applying Common Core Standards: Number and Quantity, Algebra, Function, Modeling, and Geometry.	
<b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i> Assessments will be summative and formative, written, verbal and practical. Students will be able to:	
<b>General</b> <ul style="list-style-type: none"> <li>Explain and demonstrate knowledge of mathematical concepts of as they relate to construction activities.</li> <li>Observation of correct and accurate applications of mathematic concepts in the performance of practical construction activities in the classroom and shop.</li> <li>Demonstrate through written tasks and examinations the concepts and skills in using mathematics related to construction operations.</li> <li>Work in groups to apply mathematics principles in practical construction activities.</li> <li>Use technology-based tools, printed documentation, and other media sources to research and make presentations of mathematical solutions to practical construction related activities.</li> </ul>	
<b>English/Language Arts</b> Students will demonstrate ELA competencies through several classroom and laboratory activities similar to: <ul style="list-style-type: none"> <li>Synthesize into coherent written products the culmination of mathematical activities related to construction operations such as estimating, scheduling, or budgeting.</li> </ul>	

- Participate in collaborative activities to solve construction problems with mathematical techniques and present findings to the larger group.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

**Mathematics** – Math is a ubiquitous skill in construction and thus has application throughout the Core Plus Construction program. Specific “math” performance assessments are not provided here because they are expressed in all the other topics of CPC.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work in small groups, with partners and as individuals to complete assignments and projects

Students will lead and guide others as they develop and apply knowledge skills and abilities

Students will reflect on their decisions, actions, and skill development through self-evaluations on assigned projects

Students will work together as peer evaluators to provide constructive feedback on skill improvement

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Equations and Inequalities**

- Apply properties of real numbers
- Evaluate and simplify algebraic expressions
- Solve linear equations
- Rewrite formulas and equations



- Use problem solving strategies and models
- Solve linear inequalities
- Solve absolute values

#### **Linear Equations and Functions**

- Represent relations and functions
- Find slope and rate of change
- Graph equations of lines
- Write equations of lines
- Model direct variation
- Draw scatter plots and best-fitting lines

#### **Linear Systems and Matrices**

- Solve linear systems graphically
- Solve linear systems algebraically

#### **Quadratic Functions**

- Write quadratic functions and models and use to solve problems

#### **Attributes and Relationships of Geometric Objects**

- Define Pythagorean Theorem and solve problems involving right triangles
- Understand and apply theorems about circles
- Explain volume formulas and use them in solving problems
- Apply geometric concepts in modeling situations

#### **Counting Methods and Probability**

- Apply counting principles and permutations
- Define and use probability
- Determine expected values

#### **Data Analysis and Statistics**

- Collect and interpret quantitative data
- Use normal distributions
- Draw conclusions from samples

#### **Trigonometric Functions**

- Apply right triangle trigonometry
- Write and apply trigonometric functions and models

### **Aligned Washington State Academic Standards**

**English Language Arts: Common Core**

ANCHOR STANDARDS

- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

- W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

	<p>W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)</p> <p>W.11-12.5 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. (WHST.11-12.5,)</p> <p>W.11-12.7. 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. (WHST.11-12.7)</p> <p><u>SPEAKING AND LISTENING</u></p> <p>SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, C, and D)</p> <p>SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p>

HS.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

HS.A.REI.4 Solve quadratic equations in one variable.

HS.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line  $y = -3x$  and the circle  $x^2 + y^2 = 3$ .

HS.A.REI.10 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).

HS.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphHS. and tables in terms of the quantities, and sketch graphHS. showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.\*

HS.F.IF.6 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.\*

### **Analyze functions using different representations.**

HS.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*

HS.F.IF.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima.

HS.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.

HS.F.LE.1.B Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

HS.F.LE.1.C Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

HS.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

HS.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

HS.F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

HS.G.CO.6v Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

HS.G.CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

HS.G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

HS.G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.

HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.\*

HS.G.C.1 Prove that all circles are similar.

HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

HS.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically

HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

HS.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.\*

HS.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.\*

HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).

	<p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.ID.4 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.</p> <p>HS.S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.</p> <p>HS.S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.</p> <p>HS.S.ID.6.A 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.</p> <p>HS.S.ID.6.B Informally assess the fit of a function by plotting and analyzing residuals.</p> <p>HS.S.ID.6.C Fit a linear function for a scatter plot that suggests a linear association.</p> <p>HS.S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.</p> <p>HS.S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.</p> <p>HS.S.ID.9 Distinguish between correlation and causation.</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p>

	MP5 Use appropriate tools strategically. MP6 Attend to precision. MP7 Look for and make use of structure. MP8 Look for and express regularity in repeated reasoning.	
Science	HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Developing and Using Models	ETS1.B: Developing Possible Solutions	Systems and System Models
Using Mathematics and Computational Thinking	ETS1.C: Optimizing the Design Solution	
Analyzing and Interpreting Data		
Obtaining, Evaluating, and Communicating information		

Unit 8: Applied Physics	Total Learning Hours for Unit: 30
<b>Unit Summary:</b> Students will gain the knowledge of the primary laws of physics and how they apply to construction, including safety considerations involving the workplace use of force and power.	
<b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i> Assessments will be summative and formative, written, verbal and practical. Students will be able to:	
<b>General</b> <ul style="list-style-type: none"> <li>Explain and demonstrate knowledge of physics concepts of as they relate to construction activities.</li> <li>Observation of correct and accurate applications of physics concepts in the performance of practical construction activities in the classroom and shop.</li> <li>Demonstrate through written tasks and examinations the concepts and skills in using physics related to construction operations.</li> </ul>	

- Work in groups to apply physics principles in practical construction activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of physics solutions to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Cite six examples of friction in construction operations and explain how it is a benefit or a problem on construction projects.
- Write a procedure for determining the required and the actual density of concrete for building foundation systems.
- Describe six simple machines on a construction project and write an analysis of how they reduce the amount of work required.
- Evaluate the thermal properties of three different building envelope products and synthesize a cost benefit report with a recommended product.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- 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.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate the friction force between surfaces and determine the reduction of the frictional force from the application of several lubricants.
- Compute the density of concrete and show how increasing density can support increasing load.
- Determine the ratio of mechanical advantage of several simple machines from wheelbarrows to cranes.
- Calculate the heat transfer of three different building envelope products and synthesize a cost benefit report with a recommended product.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will demonstrate professional communication through peer evaluations on project specific skills and general shop abilities

Students will lead and guide others as they develop and apply knowledge, skills, and abilities

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)



- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Matter and Mass**

- Define physics
- Explain the relationship between matter and mass, and name the three states of matter.
- Define weight and gravity, and how weight relates to mass.
- Solve for weight, mass and gravity using the given formula(s) and using appropriate units.
- Define density and solve for density, mass, volume using the given formula(s) and using appropriate units.
- Define Specific Gravity and calculate a Specific Gravity ratio given density or weight of an object.
- Explain how density is dependent on temperature and pressure
- Define energy and name the two types of energy in objects.

#### **Force, Work and Power**

- Define force, work and power.
- Apply the appropriate English and Metric units to force, work and power.
- Describe the force of friction.
- Apply torque and identify its units.
- Convert between Horsepower and watts.

#### **Simple Machines, Stress and Motion**

- Define machines and identify simple machines.
- Distinguish between different types of levers and inclined planes.
- Define mechanical advantage and calculate it using force/distance variables.
- Solve for mechanical work using effort and resistance variables.
- Define stress and its effects; define motion.
- Distinguish between speed and velocity; explain how they are related to acceleration.

#### **Heat and Pressure**

- Define heat, its relation to kinetic energy, and its units in both English and Metric.
- List and describe forms of energy which can be converted to heat.
- Explain how heat is transferred and list three methods of heat transfer.
- Define Thermal Efficiency.
- Define Specific Heat and solve for Thermal Expansion.

- Define pressure, list different pressure gauges, and practice solving for psi.

### Gas Laws and Fluid Mechanics

- Define gas laws, and use them to solve for pressure, temperature or volume.
- Identify the various components of air.
- Explain how density is dependent on temperature and pressure
- Define buoyancy and determine if something will sink or float using the buoyancy formula.
- Calculate conversion problems

### Aligned Washington State Academic Standards

#### English Language Arts: Common Core

#### ANCHOR STANDARDS

- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level;

demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

READING INFORMATIONAL TEXTS

RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

WRITING

W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)

W.11-12.5 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. (WHST.11-12.5.)

W.11-12.7. 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. (WHST.11-12.7)

SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, C, and D)

SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

LANGUAGE

L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

SCIENCE AND TECHNICAL SUBJECTS

RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

	<p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>HS.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>HS.A.REI.4 Solve quadratic equations in one variable.</p> <p>HS.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line <math>y = -3x</math> and the circle <math>x^2 + y^2 = 3</math>.</p> <p>HS.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>HS.F.IF.6 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.*</p> <p>HS.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*</p> <p>HS.F.IF.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>HS.F.IF.7.C Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.</p>

	<p>HS.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>HS.F.LE.1.B Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>HS.F.LE.1.C Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.</p> <p>HS.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).</p> <p>HS.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p> <p>MP7 Look for and make use of structure.</p> <p>MP8 Look for and express regularity in repeated reasoning.</p>
<b>Science</b>	<p>HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.</p> <p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p>

	<p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Systems and System Models
Developing and Using Models	ETS1.C: Optimizing the Design Solution	Cause and Effect
Using Mathematics and Computational Thinking	PS2.A. Forces and Motion	
Analyzing and Interpreting Data		
Obtaining, Evaluating, and Communicating Information		

Unit 9: Construction Rigging	Total Learning Hours for Unit: 20
<p><b>Unit Summary:</b> The Rigging unit is designed to prepare students to carry out a hands-on skill practice for rigging a load, lifting it and moving it, which includes: determining lifting task and job-site requirements, characterization of the load, selection of rigging equipment, safety precautions, and techniques and procedures for lifting, maneuvering, and moving the load.</p>	
<p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p>	
<p><b>General</b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of Rigging concepts of as they relate to construction activities.</li> <li>• Observation of correct and accurate applications of Rigging concepts in the performance of practical construction activities in the classroom and shop.</li> <li>• Demonstrate through written tasks and examinations the concepts and skills in using Rigging related to construction operations.</li> <li>• Work in groups to apply Rigging principles in practical construction activities.</li> <li>• Use technology-based tools, printed documentation, and other media sources to research and make presentations of Rigging techniques to practical construction related activities.</li> </ul>	

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Formulate a written rigging plan by evaluating the relevant lift factors and selecting the appropriate hardware and rigging configurations.
- For a given lift scenario, assess the proposed lift options and explain/defend the best plan for the operation. Present the rationale and the relevant supporting data to persuade the audience of the decision.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate sling angle and corresponding sling stress.
- Determine the ratio of mechanical advantage of several simple machines from wheelbarrows to cranes.
- Calculate the friction force between surfaces and determine the reduction of the frictional force from the application of several lubricants.
- Compute the tensile strength of various rigging devices and hardware.
- Calculate sling configurations for various load lifts.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will develop the ability to lead and guide others by serving as peer project guides and elbow partners

Students will be responsible for themselves and others while working in the shop environment and call out any unsafe behavior they witness

Students will work collaboratively with others in small groups, partnerships and as individuals to complete projects in a safe and effective manner

Students will lead others in safety presentations and discussions

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)

- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Lift Planning**

- Refer to the ANSI/ASME standards that are observed regarding lifting and moving loads
- List, explain and answer the four questions that must be asked before planning a lift or move.
- Determine whether a proposed load movement would be classified as a critical lift, pre-engineered lift, or ordinary lift.
- State the four major steps in planning a move, including two elements of what to look for in each step.
- Apply elements of an ordinary lift plan to an actual lift.
- Describe basic rigging safety practices

#### **Calculating Load**

- Measure and determine the volume of a load.
- Convert measurements expressed in different units into common units.
- Calculate the weight of a load.
- Determine the Center of Gravity(C/G) for a symmetrical load.
- Determine the Center of Gravity (C/G) for an asymmetric load.
- Determine the parameters of sling stress or sling angle factors.

#### **Rigging Hardware**

- Identify types of rigging, describe their features, and explain uses & inspection criteria.
- Differentiate in detail between three examples of steel rigging and three examples of synthetic rigging
- Select and inspect rigging for an actual load lift and movement
- Explain basic hitch configurations and connections.

#### **Cranes**

- Distinguish between the various types of cranes, hoists and lifting devices encountered at a work sites
- Conduct a pre-operational crane or hoist inspection.
- Rig a load for lift and movement

#### **Signaling**

- Perform hand signals to direct the load movement.

### **Aligned Washington State Academic Standards**

**English Language Arts: Common Core**

ANCHOR STANDARDS



- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

- W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

- W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)
- W.11-12.5 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. (WHST.11-12.5,)
- W.11-12.7. 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. (WHST.11-12.7)

#### SPEAKING AND LISTENING

- SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, C, and D)
- SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

#### LANGUAGE

- L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

#### SCIENCE AND TECHNICAL SUBJECTS

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.G.CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.</p> <p>HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p> <p>HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*</p> <p>HS.G.C.1 Prove that all circles are similar.</p> <p>HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</p> <p>HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p> <p>HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</p> <p>HS.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*</p> <p>HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p>
<p><b>Mathematical Practices</b></p>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>
<p><b>Science</b></p>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p>

	<p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Developing and Using Models	ETS1.B: Developing Possible Solutions	Systems and System Models
Using Mathematics and Computational Thinking	ETS1.C: Optimizing the Design Solution	
Analyzing and Interpreting Data		
Obtaining, Evaluating and Communicating Information		

Unit 10: Hydraulics	Total Learning Hours for Unit: 30
<p><b>Unit Summary:</b> In this unit, students will receive an essential foundation in the physics, calculations, processes, terminology, and safety practices related to hydraulic and pneumatic systems.</p> <p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of hydraulics/pneumatics concepts of as they relate to construction activities.</li> <li>• Observation of correct and accurate applications of hydraulics/pneumatics concepts in the performance of practical construction activities in the classroom and shop.</li> <li>• Demonstrate through written tasks and examinations the concepts and skills in using hydraulics/pneumatics related to construction operations.</li> <li>• Work in groups to apply hydraulics/pneumatics principles in practical construction activities.</li> <li>• Use technology-based tools, printed documentation, and other media sources to research and make presentations of hydraulics/pneumatics solutions to practical construction related activities.</li> </ul> <p><b>English/Language Arts</b></p> <p>Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:</p>	

- Describe the advantages and disadvantages of fluid power integrating information from multiple textual sources.
- Compose “How To” for the operation of three hydraulic systems used in construction and include specific textual evidence of the primary hydraulic principles used in each system.

### **Science**

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.\*
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate the force of a simple hydraulic system and explain how the process can be used on construction sites.
- Determine the compressibility of several fluids and explain how this affects their use in construction.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will lead and guide others as they develop and apply knowledge skills and abilities

Students will work together as peer evaluators to provide constructive feedback on skill improvement

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

#### **Hydraulics**

- Explain the physics guiding hydraulics.

- Calculate problems related to fluid power using Pascal's Law, Force, Work, and Power equations.
- Identify the major historical events (and figures) behind the science of fluids.
- Describe the advantages and disadvantages of fluid power.
- Identify and explain the factors to consider when setting up a hydraulic system.
- Define terminology common to hydraulics.
- List the typical components of a basic hydraulics system.
- Recognize the fluid power components from schematics.
- Learn and practice safe handling procedures of hydraulics.
- Apply the knowledge of hydraulics with a hands-on project.

### Aligned Washington State Academic Standards

<p><b>English Language Arts: Common Core</b></p>	<p><u>ANCHOR STANDARDS</u></p> <p>CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p> <p>CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup></p> <p>CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.</p> <p>CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.</p> <p>CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.</p> <p>CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.</p> <p>CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.</p> <p>CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.</p> <p>CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.</p>
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CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

READING INFORMATIONAL TEXTS

RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

WRITING

W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)

W.11-12.5 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. (WHST.11-12.5,)

W.11-12.7. 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. (WHST.11-12.7)

SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, C, and D)

SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

LANGUAGE

L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

SCIENCE AND TECHNICAL SUBJECTS

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

	<p>RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>HS.A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>HS.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>HS.A.REI.4 Solve quadratic equations in one variable.</p> <p>HS.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line <math>y = -3x</math> and the circle <math>x^2 + y^2 = 3</math>.</p> <p>HS.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>HS.F.IF.6 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.*</p>



	<p>HS.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*</p> <p>HS.F.IF.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima.</p> <p>HS.F.IF.7.C Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.</p> <p>HS.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>HS.F.LE.1.B Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>HS.F.LE.1.C Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.</p> <p>HS.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p> <p>MP7 Look for and make use of structure.</p> <p>MP8 Look for and express regularity in repeated reasoning.</p>
<b>Science</b>	<p>HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</p>

	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Developing and Using Models	PS3.A: Definitions of Energy	Systems and System Models
Analyzing and Interpreting Data	ETS1.C: Optimizing the Design Solution	Energy and Matter
Obtaining, Evaluating and Communicating Information	ETS1.B: Developing Possible Solutions	
Using Mathematics and Computational Thinking		

Unit 11: Fasteners	Total Learning Hours for Unit: 15
<p><b>Unit Summary:</b> Students will gain an understanding of the various fasteners utilized in the construction industry. Through applied practice students will be able to identify the correct fastener for various materials and construction processes.</p> <p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p><b>NOTE:</b> The subject of Fasteners is integrated with materials/materials science, safety and construction tools. Performance assessments should likewise involve all these related subjects in common construction applications.</p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of fastening concepts of as they relate to construction activities.</li> <li>• Observation of correct and accurate applications of fastening concepts in the performance of practical construction activities in the classroom and shop.</li> <li>• Demonstrate through written tasks and examinations the concepts and skills in using fasteners related to construction operations.</li> <li>• Work in groups to apply fastening principles in practical construction activities.</li> </ul>	

- Use technology-based tools, printed documentation, and other media sources to research and make presentations of fastening solutions to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Research and describe how adhesives work to bond materials together.
- Using Internet resources, determine and explain why nail sizes are defined by the unit “penny” and how/why that unit is annotated. Building on the preceding activity, create a chart that shows the fastening or holding capacity of nails by size.
- Citing all sources used, explain how nails and screws function as simple machines and make use of frictional force.
- Argue that welding metals is or is not considered “fastening” and use the science of friction and bonding to explain your position.

### **Science**

- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate competing design solutions 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.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate the friction force of several screw sizes and identify their uses on construction projects.
- Compute the shear capacity of several screws, nails, and bolts and determine the best applications of each.
- Given the bonding capacity of several adhesives, calculate the amount of adhesive required to join materials in various construction applications.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will demonstrate professional communication through peer evaluations on project specific skills and general shop abilities

Students will reflect upon their own actions and decisions through self-evaluations on assigned projects

Students will work in small groups, with partners, and as individuals to determine the appropriate materials to use to complete assigned skill building and group projects

Students will lead and guide others as they develop and apply knowledge, skills, and abilities

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)

- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Fastening Systems: General**

- Identify the components of a fastening system using nuts and bolts
- Specify the materials and style from which bolts and nuts are made
- Distinguish between sheer and tension types of stress/load
- List the four forces acting on installed bolts
- Categorize and properly operate a torque wrench
- Student Booklet: Reading, Writing, and Activities

#### **Permanent Fasteners**

- Discuss permanent fasteners and identify features of hex-drive and lockbolts
- Explain the limitations of lockbolts, detailing how they are used to fasten materials together
- Demonstrate normal procedures for installation of lockbolt fasteners

#### **Screws**

- Identify the different types of screws that are used in construction
- Explain which screws to use in a specific application
- Identify specific physical characteristics of screws
- Explain the different installation methods

#### **Nails**

- Identify the different types of nails that are used in construction
- Explain which nails to use in a specific application
- Identify specific physical characteristics of nails
- Identify the different sizes of nails and their meanings
- Explain the different installation methods

#### **Adhesives**

- Identify the different types of adhesives that are used in construction
- Indicate specific applications and the type of adhesives used
- Provide a basic understanding of the physical make-up for the different adhesives
- Explain the different techniques for applying adhesives.

### **Aligned Washington State Academic Standards**

**English Language Arts: Common Core**

ANCHOR STANDARDS

- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

- W.11-12.1.D Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- W.11-12.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (WHST.11-12.2 )
- W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4 )
- W.11-12.5 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. (WHST.11-12.5)
- W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )
- W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (WHST.11-12.8 )
- W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. ( WHST.11-12.9)

#### SPEAKING AND LISTENING

- SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)
- SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
- SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

#### LANGUAGE

- L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

	<p>L.11-12.4.D Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.G.CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.</p> <p>HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p> <p>HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*</p> <p>HS.G.C.1 Prove that all circles are similar.</p>

	HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. HS.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.* HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*		
Mathematical Practices	MP1 Make sense of problems and persevere in solving them. MP2 Reason abstractly and quantitatively. MP3 Construct viable arguments and critique the reasoning of others. MP4 Model with mathematics. MP5 Use appropriate tools strategically. MP6 Attend to precision.		
Science	<b>NOTE:</b> The subject of Fasteners is integrated with materials/materials science, safety and construction tools. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.		
Science and Engineering Practice		Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions		ETS1.B: Developing Possible Solutions	Influence of Science, Engineering, and Technology on Society and the Natural World
Obtaining, Evaluating, and Communicating Information		ETS1.C: Optimizing the Design Solution	

<b>Unit 12:</b> Electricity in Construction	<b>Total Learning Hours for Unit:</b> 40
<p><b>Unit Summary:</b> Introduction to the foundational concepts of electricity and the safe and proper way to work with electrically charged equipment. Basic electrical installation will be covered through hands on practice, group work and individual projects.</p>	
<p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p>	
<b>General</b>	



- Explain and demonstrate knowledge of electrical concepts of as they relate to construction activities.
- Observation of correct and accurate applications of electrical concepts in the performance of practical construction activities in the classroom and shop.
- Demonstrate through written tasks and examinations the concepts and skills in using electricity related to construction operations.
- Work in groups to apply electrical principles in practical construction activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of electrical applications in practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Describe six methods for producing a voltage (emf) and state the operating principles of and the uses for each method.
- Conduct a small research project to determine how a Ground Fault Circuit Interrupter works and why it is a critical safety feature.
- Compare and contrast the role of ions in electrical current and in the bonding process of adhesives.
- Translate and an electrical schematic diagram into a textual description being careful to define all symbols and key concepts.

### **Science**

- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.\*
- Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
- Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate electrical resistance and voltage flow through various construction materials.
- Compute the voltage differential for Ground Fault Circuit Interrupters.
- Calculate the resistance in standard spot welding for different types of metals/alloys.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work collaboratively with others to complete assigned projects both in the classroom and shop/lab setting

Students will reflect upon their own actions and decisions through self-evaluations on assigned projects

Students will practice professional communication and behavior through peer evaluations on assigned projects

Students will develop the ability to lead and guide others by serving as peer project guides and elbow partners

Students will recognize their role in the health and wellbeing of all members of the class

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

#### **Science of Basic Electricity**

- State the difference between electricity and electronics
- Describe the basic structure of the atom
- List the parts of a molecule.
- Discuss the relationship of atoms, protons, neutrons and ions
- Describe how an atom becomes an ion
- State the meanings of and the relationship between matter, element, nucleus, compound, molecule, mixture, atom, electron, proton, neutron, energy, valence, valence shell, and ion.
- State, in terms of valence, the differences between a conductor, an insulator, and a semiconductor, and list some materials which make the best conductors and insulators.
- Explain the process of conductance
- Describe the fundamental concepts of electricity
- Discuss the concept of static electricity and how it relates to charged bodies, Coulomb's Law of Charges, and electric fields.
- Describe the importance of observing electrical safety.

#### **Voltage, Current, and Resistance**

- Explain the concept of potential energy and how it relates to electrical potential and voltage
- State, using the water analogy, how a difference of potential (a voltage or an electromotive force) can exist. Convert volts to microvolts, to millivolts, and to kilovolts.
- Describe six methods for producing a voltage (emf) and state the operating principles of and the uses for each method.
- Distinguish between wet cells and dry cells, giving examples of each.
- Distinguish between primary cells and secondary cells, explaining the difference.
- Define the term "battery" when used as a power source.
- State the meanings of electron current, random drift, directed drift, and ampere, and indicate the direction that an electric current flows.

- State the relationship of current to voltage and convert amperes to milliamperes and microamperes.
- State the definitions of and the terms and symbols for resistance and conductance, and how the temperature, contents, length and cross-sectional area of a conductor affect its resistance and conductance values.
- List the physical and operating characteristics of and the symbols, ratings, and uses for various types of resistors; use the color code to identify resistor values.
- Calculate resistance values, voltage and wattage using Ohm's Law.
- Describe the importance of observing electrical safety
- Describe why electrical safety hazards occur
- Describe grounding
- Describe how different current levels affect the human body
- Describe the ways in which electric shock can be received
- List the steps that should be followed when treating an individual who receives an electric shock
- Describe the causes and the danger of burns caused by electricity
- Describe how various types of electrical devices are engineered to prevent electrical hazardous conditions from occurring

#### **Electrical Circuits**

- Explain the process of current flow.
- List the six sources of electricity and explain how they produce electrical pressure.
- List the requirements of an electrical circuit.
- Define voltage and its unit of measurement, then write the letter abbreviation for the unit.
- Define current and its unit of measurement, then write the letter abbreviation for the unit.
- Define resistance and its unit of measurement, then write the letter abbreviation for the unit.
- Define power and its unit of measurement, then write the letter abbreviation for the unit.
- Define conductance and its unit of measurement, then write the letter abbreviation for the unit.
- List the factors that determine resistance of wires, their current carrying capacity, and be able to size them.
- Describe the construction of various types of variable resistors and explain the applications they are used for.
- Describe the operation, terms and symbols of circuit protection devices.
- Identify standardized symbols used in schematic diagrams that represent various electronic components.
- Following a schematic diagram, assemble a simple electric circuit.
- Describe the relationships of current, voltage, and resistance.
- Use Ohm's Law equations to solve for electrical circuit values.
- Describe branch circuits/ transformers/ circuit breakers/ panels/ and basic circuit materials (ie Romex/ conductors/ conduit)

#### **Aligned Washington State Academic Standards**

<b>English Language Arts: Common Core</b>	<p><u>ANCHOR STANDARDS</u></p> <p>CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.</p>
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- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
- RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

#### WRITING

- W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

- W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. ( WHST.11-12.4)
- W.11-12.5 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. (WHST.11-12.5)
- W.11-12.7. 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. (WHST.11-12.7)
- W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (WHST.11-12.9)

#### SPEAKING AND LISTENING

- SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A, B, and D)
- SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

#### LANGUAGE

- L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
- L.11-12.4.D. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 11-12 reading and content*, choosing flexibly from a range of strategies. (includes 4.A, 4.B, 4.C, 4.D, ALL.4)
- L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### SCIENCE AND TECHNICAL SUBJECTS

- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

	<p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphHS. and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p><u>ALGEBRA</u></p> <p>HS.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</p> <p>HS.A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>HS.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>HS.A.REI.4 Solve quadratic equations in one variable.</p> <p>HS.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line <math>y = -3x</math> and the circle <math>x^2 + y^2 = 3</math>.</p> <p>HS.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphHS. and tables in terms of the quantities, and sketch graphHS. showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*</p> <p>HS.F.IF.6 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.*</p> <p>HS.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*</p> <p>HS.F.IF.7.A Graph linear and quadratic functions and show intercepts, maxima, and minima.</p>

	<p>HS.F.IF.7.C Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.</p> <p>HS.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.</p> <p>HS.F.LE.1.B Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</p> <p>HS.F.LE.1.C Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.</p> <p>HS.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).</p> <p>HS.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p> <p>MP7 Look for and make use of structure.</p>
<b>Science</b>	<p>HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.</p> <p>HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</p>

	<p>HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Constructing Explanations and Designing Solutions	ETS1A: Defining and Delimiting an Engineering Problem	Influence of Science, Engineering, and Technology on Society and the Natural World
Developing and Using Models	ETS1.B: Developing Possible Solutions	Cause and Effect
Obtaining, Evaluating and Communicating Information	ETS1.C: Optimizing the Design Solution	Energy and Matter
	PS3.A: Definitions of Energy	Patterns
	PS3.D: Energy in Chemical Processes	
	PS3.C: Relationship Between Energy and Forces	
	PS1.B: Chemical Reactions	

Unit 13: Company Organization and Operations	Total Learning Hours for Unit: 5
<p><b>Unit Summary:</b> An overview of the organizational structure that exists around construction project. Students will learn about the roles and responsibilities of the various parties involved in the construction process from concept and design to planning, permitting, bidding and building of the project. Lean construction principles will be covered as they relate to solving organizational issues.</p>	
<p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p>	
<p><b>General</b></p> <ul style="list-style-type: none"> <li>Explain and demonstrate knowledge of company organizational and operational concepts of as they relate to construction activities.</li> <li>Observation of correct and safe applications of company organizational and operational concepts in the performance of practical construction activities in the classroom and shop.</li> <li>Demonstrate through written tasks and examinations the concepts of company organization and operations related to the construction industry.</li> <li>Work in groups to apply company organizational and operational concepts in instructional activities.</li> </ul>	



- Use technology-based tools, printed documentation, and other media sources to research and make presentations of company organizational and operational concepts as solutions to practical construction related activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Explain the basic concepts of LEAN Construction and compose an application of LEAN principles to solve an organizational problem.
- Research and present the role and responsibilities of a regulatory agency with jurisdiction of construction projects.
- Given a description of a construction project, create an organizational chart with the necessary roles and responsibilities to effectively and safely conduct the work. Present the chart and information to the class.
- Compare and contrast union and non-union labor organizations and present the advantages and disadvantages of each.

### **Science**

- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Use basic LEAN Construction techniques to calculate work (production) efficiency and waste reduction.
- Analyze production data to determine operational effectiveness and make recommendations for improvement.

### **Leadership Alignment:**

Students will develop the ability to lead and guide others by serving as peer project guides and elbow partners

Students will be responsible for themselves and others while working in the shop environment and call out any unsafe behavior they witness

Students will work collaboratively with others in small groups, partnerships and as individuals to complete projects in a safe and effective manner

Students will lead others in safety presentations and discussions

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.2, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

**Industry Standards and/or Competencies:**

Student will be able to:

**Basic Organization of a Construction Company**

- Understand and be able to articulate the organizational structure of a construction company
- Analyze and explain the relationships on an organizational chart.
- Describe the titles and general duties of typical roles in a standard construction company.

**Systems, Processes, and Procedures**

- Describe the difference between systems, processes and procedures
- Explain the importance of systems, processes, and procedures in an organization
- Create basic systems, processes, and procedures to support a fictional company.
- Discern the processes depicted in representations of construction projects.
- Explain and apply basic concepts of LEAN Construction

**Regulatory Agencies:**

- Name the key regulatory agencies supporting construction projects.
- Describe the role of regulatory agencies in the construction industry.

**Aligned Washington State Academic Standards****English Language Arts: Common Core**ANCHOR STANDARDS

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>

CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.

CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

	<p>CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.</p> <p>CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.</p> <p>CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.</p> <p><u>READING INFORMATIONAL TEXTS</u></p> <p>RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.</p> <p>RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).</p> <p>RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.</p> <p><u>WRITING</u></p> <p>W.11-12.1.D Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.</p> <p>W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2,)</p> <p>W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)</p> <p>W.11-12.5 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. (WHST.11-12.5)</p> <p>W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )</p> <p>W.11-12.7. 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;</p>
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synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (WHST.11-12.7)

W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (WHST.11-12.8 )

W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (CCRA.W.9, WHST.11-12.9)

#### SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)

SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.

#### LANGUAGE

L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

L.11-12.4.D Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

#### HISTORY/SOCIAL STUDIES

RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.

	<p>RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<b>Mathematics: Common Core</b>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>
<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>

	<p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Influence of Science, Engineering, and Technology on Society and the Natural World
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Patterns
Developing and Using Models	ETS1.C: Optimizing the Design Solution	Energy and Matter
Using Mathematics and Computational Thinking		Systems and System Models
Obtaining, Evaluating, and Communicating Information		

Unit 14: Planning and Scheduling	Total Learning Hours for Unit: 30
<p><b>Unit Summary:</b> Students will come to understand the value and importance of planning and scheduling as they relate to the successful completion of a construction project through group work as well as independent assignments.</p>	
<p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i></p> <p>Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p>	
<p><b>General</b></p> <ul style="list-style-type: none"> <li>• Explain and demonstrate knowledge of planning and scheduling as they relate to construction projects.</li> <li>• Observation of correct applications of planning and scheduling concepts in the performance of construction activities in the classroom and shop.</li> <li>• Demonstrate through written tasks and examinations the concepts of planning and scheduling related to construction performance improvement.</li> <li>• Work in groups to apply planning and scheduling concepts in instructional activities.</li> <li>• Use technology-based tools, printed documentation, and other media sources to research and make presentations of planning and scheduling concepts as solutions to practical construction related challenges.</li> </ul>	
<p><b>English/Language Arts</b></p> <p>Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:</p> <ul style="list-style-type: none"> <li>• Compose the structure for an effective project plan and define the purpose of each section.</li> <li>• Describe the interrelationship between project schedule, budget, and the concept of productivity.</li> </ul>	

- Explain what a Work Breakdown Structure is and how it functions in a project schedule.
- Explain the positive impacts to construction projects of cultural, gender, ethnic, and philosophical diversity. Synthesize a statement to serve as the guiding principle for ensuring inclusiveness and full acceptance of people on the construction site.
- Prepare an argument for what are the top three soft skills needed to be successful in a construction career.

### **Science**

- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Using construction drawings, estimating techniques, and schedule, create a project budget.
- Given customary overhead cost factors, calculate the overhead cost and profit for a project.
- Presented with various scenarios of production, determine the rates of change on project schedule.
- Calculate amounts of materials needed by linear and volumetric dimensions then determine costs and impact to budget.
- Develop cost models for construction budgets based on material quantities and structure size.
- Calculate organizational productivity as a function of revenue, labor/effort, and efficiency. Plot various productivity rates over time.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work collaboratively in small groups to develop a workplan and timeline for assigned group projects

Students will work independently managing their time to complete skill development projects

Students will work as a collective to maintain a safe work environment

Students will demonstrate professional communication and through peer evaluations

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.2, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

## **Industry Standards and/or Competencies:**

Student will be able to:

### **Why do we Plan and Schedule**

- Describe the history of scheduling
- Explain key terms used in scheduling
- Identify different types of schedules we use in our daily routines
- State how planning and scheduling helps keep us organized when changes are made in our routine
- Identify the basic elements to include when creating a schedule
- Discuss the importance of a schedule strategy.
- Create a logic path.

### **Creating a New Project Schedule**

- Define what is a project
- State what is a project activity and what are activity relationships.
- Explain the key steps to planning and scheduling a construction project.
- Show how changing variables impact the schedule.
- Demonstrate the basic functions of developing a schedule using MS Project

### **Organizing a Project Schedule**

- Use MS Project to perform basic operations to alter and update project schedules including:
  - Calendars
  - Hierarchy
  - Formatting Columns
  - Work Breakdown Structure

### **Formatting and Printing in MS Project**

- Demonstrate how to format and print a project schedule
- Identify a schedule critical path.

### **Managing the Project Schedule**

- Create a baseline schedule
- Demonstrate how to update schedules
- Explain the how to actualize the schedule
- Show how to document a delay and represent it in the project schedule

## **Aligned Washington State Academic Standards**

### **English Language Arts: Common Core**

### ANCHOR STANDARDS



- CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup>
- CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
- CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.
- CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.
- CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
- CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.

#### READING INFORMATIONAL TEXTS

- RI.11-12.1 - Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
- RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines faction in Federalist No. 10).

RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.

WRITING

W.11-12.1.D Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11-12.2. Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. (Includes 2.A, 2.B, 2.C, 2.D, 2.E, 2.F, WHST.11-12.2)

W.11-12.2.B - Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)

W.11-12.5 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. (WHST.11-12.5,)

W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )

W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (WHST.11-12.8 )

W.11-12.9 Draw evidence from literary or informational texts to support analysis, reflection, and research. (WHST.11-12.9, )

SPEAKING AND LISTENING

SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively. (includes SL.11-12.1A and C)

SL.11-12.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

	<p>SL.11-12.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. )</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>HISTORY/SOCIAL STUDIES</u></p> <p>RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.</p> <p>RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.</p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p>

	<p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>																			
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<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>																			
<table><tr><th>Science and Engineering Practice</th><th>Disciplinary Core Idea</th><th>Crosscutting Concept</th></tr><tr><td>Asking Questions and Defining Problems</td><td>ETS1.A: Defining and Delimiting an Engineering Problem</td><td>Patterns</td></tr><tr><td>Constructing Explanations and Designing Solutions</td><td>ETS1.B: Developing Possible Solutions</td><td>Systems and System Models</td></tr><tr><td>Developing and Using Models</td><td>ETS1.C: Optimizing the Design Solution</td><td></td></tr><tr><td>Using Mathematics and Computational Thinking</td><td></td><td></td></tr><tr><td>Obtaining, Evaluating, and Communicating Information</td><td></td><td></td></tr></table>			Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept	Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns	Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Systems and System Models	Developing and Using Models	ETS1.C: Optimizing the Design Solution		Using Mathematics and Computational Thinking			Obtaining, Evaluating, and Communicating Information		
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**Unit 15: Estimating****Total Learning Hours for Unit: 40**

**Unit Summary:** Students will learn the basic concepts of estimating and preparing bids for various types of construction projects.

**Performance Assessments:** *These can be locally developed or use the suggested assessments below.*

Assessments will be summative and formative, written, verbal and practical. Students will be able to:

**General**

- Explain and demonstrate knowledge of estimating as used in construction projects.
- Observation of correct applications of estimating concepts in the performance of construction activities in the classroom and shop.
- Demonstrate through written tasks and examinations the concepts of estimating related to construction performance improvement.
- Work in groups to apply estimating concepts in instructional activities.
- Use technology-based tools, printed documentation, and other media sources to research and make presentations of estimating concepts as solutions to practical construction related challenges.

**English/Language Arts**

Students will demonstrate ELA competencies through several classroom and laboratory activities similar to:

- Explain each of the major factors in determining the accuracy of a cost estimate.
- Describe four reasons why a construction contractor would prepare a cost estimate.
- Prepare a flow chart of the project bid process including pre-bid, bid-day, and post-bid activities.
- Write a procedure for developing a project cost estimate using the Square Foot estimating method.
- Prepare a cost estimate using the appropriate forms for the Material Take-Off method.
- Defend the use of a risk analysis as an important component of the cost estimate.

**Science**

- Design, evaluate, and/or refine a solution to a complex real-world construction problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- Use a model based on evidence to predict the relationships between systems or between components of a system.
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

**Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Calculate amounts of materials needed by linear and volumetric dimensions then determine costs and impact to budget.
- Develop cost models for construction budgets based on material quantities and structure size.
- Use the unit price method to calculate a budget estimate based calculating square footage from project construction drawings.
- Create a bid summary spreadsheet that contains accurate formulas for all bid line items that accurately totals the project and applies sales tax.

**Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will work in small groups, with partners and as individuals to complete assignments and projects

Students will lead and guide others as they develop and apply knowledge skills and abilities

Students will reflect on their decisions, actions, and skill development through self-evaluations on assigned projects

Students will work together as peer evaluators to provide constructive feedback on skill improvement

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3, 2.C.4), and Solve Problems (2.D.1, 2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.2, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

- Explain the purpose and function of cost estimating in construction projects
- Describe the organization of the Construction Specification Institute Divisions and how they relate to estimating
- Demonstrate common estimating techniques including:
  - Square foot estimating
  - Materials/Material Take Off by CSI code
- Explain the basic considerations for estimating Earth work, concrete, steel, and wood
- Calculate labor costs and productivity rates
- Complete a project cost estimate with overhead and profit built in.
- Explain the importance of a risk analysis in preparing a cost estimate.

### **Aligned Washington State Academic Standards**

#### **English Language Arts: Common Core**

#### ANCHOR STANDARDS

CCRA.R.1 - Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

	<p>CCRA.R.7 - Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.<sup>1</sup></p> <p>CCRA.R.8 - Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.</p> <p>CCRA.W.2 - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization and analysis of content.</p> <p>CCRA.W.4 - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>CCRA.W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.</p> <p>CCRA.SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.</p> <p>CCRA.SL.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.</p> <p>CCRA.SL.6 - Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.</p> <p>CCRA.L.3 - Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.</p> <p>CCRA.L.6 - Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.</p> <p><u>READING INFORMATIONAL TEXTS</u></p> <p>RI.11-12.7 Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.</p> <p><u>WRITING</u></p> <p>W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (WHST.11-12.4)</p> <p>W.11-12.5 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. (WHST.11-12.5)</p>
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	<p>W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (WHST.11-12.6 )</p> <p><u>LANGUAGE</u></p> <p>L.11-12.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p> <p>L.11-12.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.</p> <p>L.11-12.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.</p> <p><u>SCIENCE AND TECHNICAL SUBJECTS</u></p> <p>RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i>.</p> <p>RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</p>
<p><b>Mathematics: Common Core</b></p>	<p>HS.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>HS.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.</p> <p>HS.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>HS.G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.</p> <p>HS.G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p> <p>HS.G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.</p> <p>HS.G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*</p> <p>HS.G.C.1 Prove that all circles are similar.</p>



	<p>HS.G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</p> <p>HS.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically</p> <p>HS.G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p> <p>HS.G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</p> <p>HS.G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*</p> <p>HS.G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*</p> <p>HS.G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p> <p>HS.G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*</p> <p>HS.S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).</p> <p>HS.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.</p> <p>HS.S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).</p> <p>HS.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.</p> <p>HS.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.</p> <p>HS.S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.</p> <p>HS.S.IC.6 Evaluate reports based on data.</p>
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>
<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p>

	<p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>	
Science and Engineering Practice	Disciplinary Core Idea	Crosscutting Concept
Asking Questions and Defining Problems	ETS1.A: Defining and Delimiting an Engineering Problem	Patterns
Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Systems and System Models
Developing and Using Models	ETS1.C: Optimizing the Design Solution	
Using Mathematics and Computational Thinking		
Obtaining, Evaluating, and Communicating Information		

<b>Unit 16:</b> Capstone Project	<b>Total Learning Hours for Unit:</b> 15
<p><b>Unit Summary:</b> Students will work as a team to apply the knowledge, skills and abilities gained through the previous units of instruction to complete a scaled construction project</p> <p><b>Performance Assessments:</b> <i>These can be locally developed or use the suggested assessments below.</i> Assessments will be summative and formative, written, verbal and practical. Students will be able to:</p> <p><b>General</b></p> <ul style="list-style-type: none"> <li>• Work in groups to apply materials science principles in practical construction activities.</li> <li>• Demonstrate safety practices related to tool operation, maintenance, and storage.</li> <li>• Work in group to safely use hand tools, power tools, and stationary equipment in practical construction activities.</li> <li>• Demonstrate accurate applications of safety concepts in the performance of practical construction activities in the classroom and shop.</li> <li>• Work in groups to apply safety principles in practical construction activities.</li> <li>• Utilize accurate measurement technique using standard construction measuring tools and</li> <li>• Work in group to apply measurement principles in practical construction activities.</li> <li>• Explain and demonstrate knowledge of the concepts of fractions as they relate to measurement and scale.</li> </ul>	

- Utilize correct and accurate print reading technique using standard architectural nomenclature and symbology
- Work as a team member to apply print reading principles to complete assigned project as detailed in project prints
- Demonstrate knowledge of company organizational and operational concepts of as they relate to completion of assigned project.
- Work in group to apply company organizational and operational concepts to completion of assigned project.
- Work in group to apply planning and scheduling concepts to completion of assigned project.
- Work in group to apply estimating concepts in instructional activities.

### **English/Language Arts**

Students will demonstrate ELA competencies through

- Reading construction prints and drawings to translate dimensions and decode symbols into correct scaled measurement projects.
- Translate the results of estimating materials needed for a project into a purchase order request.
- Given a set of specifications, create a drawing of the product with proper dimensions, symbols, and both an orthographic and isometric views.
- Compose the structure for an effective project plan and define the purpose of each section.

### **Mathematics**

Students will demonstrate mathematics competencies through several classroom and laboratory activities similar to:

- Perform measurement and layout activities for assigned project. Tasks will include dimensional mathematics, manipulating fractions, and extrapolating values from two-dimension representations to three dimensional products.
- Comprehend and apply the concept of scale when reading construction drawings and prints.
- Using construction drawings, to determine material quantities, convert units of measure, place orders, schedule deliveries, and construct budgets.
- Develop cost models for construction budgets based on material quantities and structure size.
- Calculate amounts of materials needed by linear and volumetric dimensions then determine costs and impact to budget.
- Consistently and accurately convert measurement values between imperial and metric units and decimals when calculating values in construction practices.
- Apply the Pythagorean Theorem to determine and verify square and plumb layout.
- Use basic trigonometry to determine roof slope (ratio of rise to run) and calculate roof area. Translate these dimensions into a quantity and complete a purchase order for the required material.
- Given the bonding capacity of several adhesives, calculate the amount of adhesive required to join materials in assigned project.
- Using construction drawings, estimating techniques, and schedule, create a project budget.
- Given customary overhead cost factors, calculate the overhead cost and profit for a project.
- Presented with various scenarios of production, determine the rates of change on project schedule.
- Calculate amounts of materials needed by linear and volumetric dimensions then determine costs and impact to budget.
- Develop cost models for construction budgets based on material quantities and structure size.

### **Leadership Alignment:**

Leadership activities should include 21st Century Skills embedded in curriculum and instruction for this unit of instruction. Include leadership skills that are being taught and assessed within the class for all students. Suggested skills include:

Students will show up to class on time and prepared to work and expect the same of their classmates

Students will work collaboratively as a team to complete assigned project that will require them to design, schedule and execute a work plan to successfully build out a construction project

Students will reflect on their decisions, actions, and skill development through self-evaluations on assigned project

Students will practice professional communication and behavior through peer evaluations on assigned project

Students will work together as peer evaluators to provide constructive feedback on skill improvement

Students will demonstrate respect for themselves and others by maintaining a safe working environment in the shop/lab setting at all times

Students are empowered and expected to enforce all safety procedures in the shop/lab setting using professional and constructive language

- Think creatively (1.A.1, 1.A.3) and Work Creatively with Others (1.B.2)
- Reason Effectively (2.A.1), Use Systems Thinking (2.B.1), Make Judgments and Decisions (2.C.1, 2.C.3), and Solve Problems (2.D.2)
- Communicate Clearly (3.A.1, 3.A.2, 3.A.3, 3.A.4, 3.A.5) and Collaborate with Others (3.B.1, 3.B.2, 3.B.3)
- Assess and Evaluate Information (4.A.1, 4.A.2) and Use and Manage Information (4.B.1, 4.B.3)
- Adapt to Change (7.A.1) and Be Flexible (7.B.1, 7.B.2)
- Manage Goals and Time (8.A.3), Work Independently (8.B.1), and Be Self-Directed Learners (8.C.1, 8.C.2)
- Interact Effectively with Others (9.A.1, 9.A.2) and Work Effectively in Diverse Teams (9.B.1, 9.B.2)
- Manage Projects (10.A.1, 10.A.2) and Produce Results (10.B.1)
- Guide and Lead Others (11.A.1, 11.A.2) and Be Responsible to Others (11.B.1)

### **Industry Standards and/or Competencies:**

Student will be able to:

- Interact respectfully with fellow human beings of different cultures, genders, and backgrounds
- Work cooperatively with others in the class
- Work cooperatively with others to complete work assignments.
- Understand the roles and responsibilities of the individual as part of a team and the hierarchy of individual positions in the construction industry
- Perform responsibly as a team member and assist other members of the work team
- Effectively communicate with all members of the group or team to achieve team goals
- Effectively resolve conflicts with co-workers to maintain a smooth workflow
- Learn from other team members
- Assist others who have less experience
- Listens to other ideas and be open to opinions and ideas that are different from your own
- Resolve conflicts and differences in a respectful manner to maintain a smooth workflow
- Treat others with honesty, fairness, and respect
- Demonstrate respect for the property of others
- Take responsibility for accomplishing work goals within accepted timeframes
- Accept responsibility for one's decisions and actions and recognize the affect your actions have on others

- Demonstrate the safe operation of hand tools.
- Perform competent operation of hand tools in their intended use.
- Properly choose and consistently wear proper PPE for hand tool use.
- Demonstrate the safe operation of the stationary equipment.
- Perform competent operation of stationary tools in their intended use.
- Properly choose and consistently wear proper PPE for equipment use.
- Choose the right mathematical method or formula to solve a problem
- Add, subtract, divide, and multiply fractions
- Add, subtract, divide, and multiply decimals
- Read gauges and measurement instruments accurately
- Use and report measurements correctly
- Find level, plumb, and square
- Identify lines, symbols, abbreviations, and nomenclature within prints
- Demonstrate correct interpretation of drawing/print information and specifications to the correct location on the plan.
- Perform necessary mathematics to determine scale and measurements
- Translate drawing information into operational plans
- Identify appropriate construction materials required for project per prints
- Handle, install, position, move, and store materials properly
- Demonstrate knowledge of various material finishing techniques
- Understand appropriate transport methods of various construction materials
- Use appropriate combinations of building materials and components
- Create a baseline project schedule
- Anticipate obstacles to project completion and develop contingency plans to address them
- Incorporate potential job disruptions into planning timelines
- Adjust plan/schedules to respond to unexpected events and conditions
- Estimate the time required to perform activities needed to accomplish a specific task
- Develop a timeline for sequencing the activities of a project/job
- Establish specific goals to accomplish work in a timely manner
- Stay on schedule

#### **Aligned Washington State Academic Standards**

##### **English Language Arts: Common Core**

CCSS.ELA-LITERACY.CCRA.L.1

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

CCSS.ELA-LITERACY.CCRA.R.10

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

	<p>CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.</p> <p>CCSS.ELA-LITERACY.CCRA.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.</p>
<b>Mathematics: Common Core</b>	<p>CCSS.MATH.CONTENT.HSN. Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p> <p>CCSS.MATH.CONTENT.HSN. Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>CCSS.MATH.CONTENT.HSA.REI. A.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.</p> <p>CCSS.MATH.CONTENT.HSG.CO. A.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.</p> <p>CCSS.MATH.CONTENT.HSG.CO. A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.</p> <p>CCSS.MATH.CONTENT.HSG.CO. A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.</p> <p>CCSS.MATH.CONTENT.HSG.CO. A.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</p> <p>CCSS.MATH.CONTENT.HSG.SRT. B.4 Prove theorems about triangles. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.</p> <p>CCSS.MATH.CONTENT.HSG.SRT. B.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p>

	<p>CCSS.MATH.CONTENT.HSG.SRT. C.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.</p> <p>CCSS.MATH.CONTENT.HSG.SRT. C.7 Explain and use the relationship between the sine and cosine of complementary angles.</p> <p>CCSS.MATH.CONTENT.HSG.SRT. C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.</p> <p>CCSS.MATH.CONTENT.HSG. C.A.2 Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</p> <p>CCSS.MATH.CONTENT.HSG.GMD. B.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.</p>	
<b>Mathematical Practices</b>	<p>MP1 Make sense of problems and persevere in solving them.</p> <p>MP2 Reason abstractly and quantitatively.</p> <p>MP3 Construct viable arguments and critique the reasoning of others.</p> <p>MP4 Model with mathematics.</p> <p>MP5 Use appropriate tools strategically.</p> <p>MP6 Attend to precision.</p>	
<b>Science</b>	<p>HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>	
<b>Science and Engineering Practice</b>	<b>Disciplinary Core Idea</b>	<b>Crosscutting Concept</b>
<p>Constructing Explanations and Designing Solutions</p> <p>Developing and Using Models</p> <p>Using Mathematics and Computational Thinking</p> <p>Analyzing and Interpreting Data</p> <p>Obtaining, Evaluating, and Communicating Information</p>	<p>ETS1.A: Defining and Delimiting an Engineering Problem</p> <p>ETS1.B: Developing Possible Solutions</p> <p>ETS1.C: Optimizing the Design Solution</p>	<p>Patterns</p> <p>Systems and System Models</p>

