



Statewide Framework Document for: 149991

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 1 credit of Algebra I.** Washington State 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.

Engineering Design I

Course Title: Engineering Design I		Total Framework Hours: 180
CIP Code: 149991	<input checked="" type="checkbox"/> Exploratory <input type="checkbox"/> Preparatory	Date Last Modified: May 4, 2015
Career Cluster: Science, Technology, Engineering, and Mathematics		Cluster Pathway: Science and Math
Eligible for Equivalent Credit in: <input checked="" type="checkbox"/> Math <input type="checkbox"/> Science		Total Number of Units: 10

Course Overview

Summary:

This course teaches problem-solving skills using a design development process. Models of product solutions are created, analyzed, and communicated using solid modeling computer design software. This framework is based on the Project Lead the Way Introduction to Engineering Design Curriculum.

Unit 1: Design Process**Total Learning Hours for Unit: 16****Performance Assessments:**

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

Students will have several performance assessments in Unit 1. Students will be presented with two different challenges with very specific constraints: Instant Challenge #1: Cable Car and Instant Challenge #2: Paper Bridge.

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.

- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards – Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop an understanding of the characteristics and scope of technology.

L. Inventions and innovations are the results of the specific, goal-directed research. (1.9-12.L)

Cluster: Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. (2.9-12.Z)

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. (2.9-12.AA)

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. (2.9-12.BB)

Cluster: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. (4.9-12.I)

J. Ethical considerations are important in the development, selection, and use of technologies. (4.9-12.J)

Cluster: Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)

Cluster: Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. (9.9-12.I)

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. (9.9-12.J)

L. The process of engineering design takes into account a number of factors. (9.9-12.L)

Cluster: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

J. Technological problems must be researched before they can be solved. (10.9-12.J)

Cluster: Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. (17.9-12.P)

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics.
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):

Reading

- 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.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
- CCRA.R.7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
- CCRA.R.10 Read and comprehend complex literary and informational texts independently and proficiently.

Writing

- 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.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
- CCRA.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
- 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.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

- 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.
- 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.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

Language

- CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
- 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 considering a word or phrase important to comprehension or expression.

Unit 2: Technical Sketching and Drawing	Total Learning Hours for Unit: 11
<p>Performance Assessments: <i>Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.</i></p> <p>This unit ends with students creating practice sketches that incorporate all of the previously learned sketching techniques (isometric, perspective, and multi-view).</p>	
<p>Leadership Alignment:</p> <ul style="list-style-type: none"> 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. The event, activity, or project and the associated 21st Century Skill should be clearly articulated. Example: Students will demonstrate the ability to communicate clearly through their group project presentation. 	
<p><i>Industry Standards and Competencies</i></p>	
<p>Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards: Cluster: Students will develop an understanding of and be able to select and use information and communication technologies. P. There are many ways to communicate information, such as graphic and electronic means. (17.9-12.P) Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)</p>	
<p><i>Aligned Washington State Standards</i></p>	
<p>Standards for Mathematical Practice (Common Core State Standards): Practice 1: Make sense of problems and persevere in solving them. Practice 2: Reason abstractly and quantitatively. Practice 3: Construct viable arguments and critique the reasoning of others. Practice 5: Use appropriate tools strategically. Practice 6: Attend to precision. Practice 7: Look for and make use of structure.</p>	
<p>Washington Mathematics Standards (Common Core State Standards): Cluster: Apply geometric concepts in modeling situations G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).</p>	
<p>Washington Arts Standards: Arts 2.0 The student demonstrates thinking skills using artistic processes. 2.1. Applies a creative process to the arts (dance, music, theatre and visual arts): - Explores, gathers, and interprets information from diverse sources. Arts 3.0 The student communicates through the arts. 3.2 Uses the arts to communicate for a specific purpose. Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work. 4.1. Demonstrates and analyzes the connections among the arts disciplines. 4.2. Demonstrates and analyzes the connections between the arts and other content areas. 4.5. Understands how arts knowledge and skills are used in the world of work including careers in the arts.</p>	

Unit 3: Measurement and Statistics**Total Learning Hours for Unit: 12****Performance Assessments:**

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

- 1) Applied Statistics Activity: Students use what they've learned from previous measurement activities to perform a statistical analysis of wooden cubes (which will be used in a later project/activity).
- 2) Instant Challenge: Fling Machine. Students will follow the design process to complete a timed task, while working collaboratively with their peers. This challenge also incorporates some of the measurement skills learned throughout the unit.

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:**

Cluster: Students will develop an understanding of the core concepts of technology.

DD. Quality control is a planned process to ensure that a product, service, or system meets established criteria. (2.9-12.DD)

Cluster: Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)

I. Design problems are seldom presented in a clearly defined form. (8.9-12.I)

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Cluster: Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. (9.9-12.I)

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. (9.9-12.J)

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. (9.9-12.K)

L. The process of engineering design takes into account a number of factors. (9.9-12.L)

Cluster: Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to assess the impact of products and systems.

J. Collect information and evaluate its quality. (13.9-12.J)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

- N.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.
- N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
- N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Interpret the structure of expressions.

- A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.
 - 1a Interpret part of an expression, such as terms, factors, and coefficients.
 - 1b Interpret complicated expressions by viewing one or more of their parts as a single entity.
- A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Cluster: Write expressions in equivalent forms to solve problems.

- A.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
 - 3a Factor a quadratic expression to reveal the zeros of the function it defines.
 - 3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
 - 3c Use the properties of exponents to transform expressions for exponential functions.
- A.SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.

Cluster: Perform arithmetic operations on polynomials.

- A.APR.A.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Cluster: Create equations that describe numbers or relationships.

- A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.

Cluster: Understand solving equations as a process of reasoning and explain the reasoning.

- A.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.
- A.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Cluster: Explain volume formulas and use them to solve problems

- G.GMD.A.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

Cluster: Apply geometric concepts in modeling situations

- G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

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

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

S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
 S.ID.A.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.

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 9-10):
 RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):
Speaking and Listening

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.
 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.

Unit 4: Modeling Skills

Total Learning Hours for Unit: 15

Performance Assessments:

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

- 1) Puzzle Cube: Students will create a puzzle cube out of wooden cubes (which they performed a statistical analysis on in the previous unit). This puzzle cube is made of 27 individual cubes, where cubes are glued together in 5 puzzle pieces. These puzzle pieces come together to form a cube. Students also use their sketching/drawing skills (learned in unit 2) to create a hand sketch of the puzzle solution.
- 2) 3D CAD Puzzle Cube: After students have physically built their puzzle cube they will create a computer sketch of their cube. Students will create the individual puzzle cube, assemble these cubes into their 5 separate puzzle pieces, create a multi-view sheet with dimensions for each piece, and finally create a video showing how their cube is assembled together.

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
 Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. (2.9-12.AA)

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. (2.9-12.BB)

Cluster: Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Cluster: Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. (9.9-12.I)

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. (9.9-12.J)

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. (9.9-12.K)

L. The process of engineering design takes into account a number of factors. (9.9-12.L)

Cluster: Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observations, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. (12.9-12.L)

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. (17.9-12.P)

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Modeling with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.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.

N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.

Cluster: Create equations that describe numbers or relationships.

A.CED.A.2 Create equations in two or more variables and use them to solve problems.

A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Solve equations and inequalities in one variable.

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

Cluster: Represent and solve equations and inequalities graphically.

A.REI.D.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, forming a curve (which could be a line)

Cluster: Understand the concept of a function and use function notation.

F.IF.A.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y=f(x)$.

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Cluster: Interpret functions that arise in applications in terms of the context.

F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically as a table) over a specified interval. Estimate the rate of change from a graph.

Cluster: Build a function that models a relationship between two quantities.

F.BF.A.1 Write a function that describes a relationship between two quantities.

1a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

Cluster: Interpret expressions for functions in terms of the situation they model.

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

Cluster: Experiment with transformations in the plane.

G.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.

G.CO.A.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).

G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.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.

Cluster: Apply geometric concepts in modeling situations.

G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

6a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data.

6c. Fit a linear function for a scatter plot that suggests a linear association.

Cluster: Interpret linear models.

S.ID.C.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Washington Science Standards (Next Generation Science Standards):

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.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):

Writing

CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

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

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

Language

CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

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 considering a word or phrase important to comprehension or expression.

Washington Arts Standards:

Arts 1.0 The student understands and applies arts knowledge and skills in dance, music, theatre, and visual arts.

1.2 Develops arts skills and techniques.

Arts 2.0 The student demonstrates thinking skills using artistic processes.

2.2 Applies a performance and/or presentation process to the arts (dance, music, theatre and visual arts):

- Identifies audience and purpose of the work and/or performance.

Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.

4.2. Demonstrates and analyzes the connections between the arts and other content areas.

4.3. Understands how the arts impact and reflect personal choices throughout life.

4.4. Understands how the arts influence and reflect culture/civilization, place and time.

4.5. Understands how arts knowledge and skills are used in the world of work including careers in the arts.

Unit 5: Geometry Design

Total Learning Hours for Unit: 13

Performance Assessments:

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

Students will have numerous performance assessments in this unit. They include:

1. Calculating properties of shapes and solids (first using paper shapes, then using 3D objects)
2. Making Sketches in CAD (Here, students will be assessed on their ability to create rather simple 3D sketches using CAD software.)
3. CAD Models (Here, students will be assessed on their ability to make modifications to previously-generated CAD sketches.)

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.

- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Modeling with mathematics.

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Interpret the structure of expressions.

A.SSE.A.1 Interpret expressions that represent a quantity in terms of its context.

1a Interpret part of an expression, such as terms, factors, and coefficients.

1b Interpret complicated expressions by viewing one or more of their parts as a single entity.

A.SSE.A.2 Use the structure of an expression to identify ways to rewrite it.

Cluster: Write expressions in equivalent forms to solve problems.

A.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

3a Factor a quadratic expression to reveal the zeros of the function it defines.

3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

3c Use the properties of exponents to transform expressions for exponential functions.

A.SSE.B.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.

Cluster: Create equations that describe numbers or relationships.

A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Cluster: Understand solving equations as a process of reasoning and explain the reasoning.

A.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.

A.REI.A.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Cluster: Solve equations and inequalities in one variable.

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

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

4b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as

appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .

Cluster: Experiment with transformations in the plane.

G.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.

G.CO.A.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).

G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.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.

Cluster: Make geometric constructions.

G.COD.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Cluster: Explain volume formulas and use them to solve problems.

G.GMD.A.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.

G.GMD.A.2 Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

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

Cluster: Visualize relationships between two-dimensional and three-dimensional objects.

G.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.

Cluster: Apply geometric concepts in modeling situations.

G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

G.MGA.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

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

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

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

S.ID.A.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.

S.ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

S.ID.A.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.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):

Speaking and Listening

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.

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.

Language

CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

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

Washington Arts Standards:

Arts 1.0 The student understands and applies arts knowledge and skills in dance, music, theatre, and visual arts.

1.2 Develops arts skills and techniques.

Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.

4.2. Demonstrates and analyzes the connections between the arts and other content areas.

4.3. Understands how the arts impact and reflect personal choices throughout life.

4.5. Understands how arts knowledge and skills are used in the world of work including careers in the arts.

Unit 6: Reverse Engineering

Total Learning Hours for Unit: 13

Performance Assessments:

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

The key performance assessment of this unit comes in the final activity. As the final stage of the reverse engineering unit, teams of students will physically disassemble their 'automoblox' (toy car that comes apart into several pieces) and give a presentation to their peers. Their presentation will include documentation of all the parts, their properties, and their functions within the automoblox. In addition, students will explain the strengths, weaknesses, and potential for improvements for each part.

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

I. Research and development is a specific problem-solving approach that is used intensively in business and industry to prepare devices and systems for the marketplace. (10.9-12.I)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

L. Document processes and procedures and communicate them to different audiences using appropriate oral and written techniques. (12.9-12.L)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Modeling with mathematics
Practice 5: Use appropriate tools strategically.
Practice 6: Attend to precision.
Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Experiment with transformations in the plane

G.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.

G.CO.A.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).

G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.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.

Cluster: Make geometric constructions

G.CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Cluster: Visualize relationships between two-dimensional and three-dimensional objects

G.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.

Cluster: Apply geometric concepts in modeling situations

G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

G.MGA.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

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

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):

Writing

CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient 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.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

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.

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

Language

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

Washington Arts Standards:

Arts 2.0 The student demonstrates thinking skills using artistic processes.

2.2 Applies a performance and/or presentation process to the arts (dance, music, theatre and visual arts):

- Identifies audience and purpose of the work and/or performance.
- Selects artistic resources, materials and/or repertoire to create, perform and present.

Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.

4.2. Demonstrates and analyzes the connections between the arts and other content areas.

Unit 7: Documentation

Total Learning Hours for Unit: 24

Performance Assessments:

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

At this point in the curriculum, students are becoming very proficient in the engineering design process and the 3D CAD software. As a result, the Performance Assessment becomes an even bigger part of the curriculum. In this unit (and in upcoming units), students will be using all of the aspects they've learned from previous units to complete a large, group task. In this unit, students will design and construct one or more "Product Enhancement(s)" for the Automoblox. Students will be required to follow the design process to create this 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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop an understanding of the core concepts of technology.

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. (2.9-12.AA)

Cluster: Students will develop an understanding of the attributes of design.

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Cluster: Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it. (11.9-12.M)

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Reason quantitatively and use units to solve problems.

N.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Cluster: Experiment with transformations in the plane.

G.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.

G.CO.A.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).

G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.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.

Cluster: Make geometric constructions.

G.CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Cluster: Visualize relationships between two-dimensional and three-dimensional objects.

G.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.

Cluster: Apply geometric concepts in modeling situations.

G.MGA.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

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

Washington Science Standards (Next Generation Science Standards):

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.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):Writing

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

CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

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.

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

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

Language

CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

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 considering a word or phrase important to comprehension or expression.

Washington Arts Standards:

Arts 1.0 The student understands and applies arts knowledge and skills in dance, music, theater, and visual arts.

1.1 Understands and applies arts concepts and vocabulary.

Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.

4.1 Demonstrates and analyzes the connections among the arts disciplines.

4.3 Understands how the arts impact and reflect personal choices throughout life.

Unit 8: Advanced Computer Modeling**Total Learning Hours for Unit: 20****Performance Assessments:**

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

Students will be working on creating CAD sketches and multi-view drawings of their sketches (which will include orthographic and auxiliary views) for one of three projects (Button Maker, Arbor Press, or Toy Train). Students will be required to produce each component (on CAD) to fully assemble their project. Students will also create a video showing how each component comes together to create their final assembly.

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:**

Cluster: Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)

I. Design problems are seldom presented in a clearly defined form. (8.9-12.I)

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Cluster: Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. (9.9-12.I)

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. (9.9-12.J)

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. (9.9-12.K)

L. The process of engineering design takes into account a number of factors. (9.9-12.L)

Cluster: Students will develop the abilities to apply the design process.

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

P. There are many ways to communicate information, such as graphic and electronic means. (17.9-12.P)

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

- Practice 1: Make sense of problems and persevere in solving them.
- Practice 2: Reason abstractly and quantitatively.
- Practice 3: Construct viable arguments and critique the reasoning of others.
- Practice 4: Model with mathematics
- Practice 5: Use appropriate tools strategically.
- Practice 6: Attend to precision.
- Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

- Cluster: Create equations that describe numbers or relationships.
 - A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems.
 - A.CED.A.2 Create equations in two or more variables and use them to solve problems.
- Cluster: Solve equations and inequalities in one variable.
 - A.REI.B.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
- Cluster: Interpret expressions for functions in terms of the situation they model.
 - F.LE.B.5 Interpret the parameters in a linear or exponential function in terms of a context.
- Cluster: Experiment with transformations in the plane.
 - G.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.
 - G.CO.A.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).
 - G.CO.A.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
 - G.CO.A.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
 - G.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.
- Cluster: Make geometric constructions.
 - G.CO.D.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).
 - G.CO.D.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.
- Cluster: Visualize relationships between two-dimensional and three-dimensional objects.
 - G.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.
- Cluster: Apply geometric concepts in modeling situations.
 - G.MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
 - G.MG.A.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
 - G.MG.A.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):

Language

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

Washington Arts Standards:

Arts 1.0 The student understands and applies arts knowledge and skills in dance, music, theatre, and visual arts.

1.1 Understands and applies arts concepts and vocabulary.

Arts 2.0 The student demonstrates thinking skills using artistic processes.

2.1. Applies a creative process to the arts (dance, music, theatre and visual arts):

- Identifies audience and purpose.
- Explores, gathers, and interprets information from diverse sources.
- Uses ideas, foundations, skills and techniques to develop dance, music, theatre and visual art.
- Implements choices of arts elements, principles, foundations, skills, and techniques in a creative work.
- Refines work based on feedback, self-reflection, and aesthetic criteria.
- Presents work to others in a performance, exhibition, and/or production.

Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.

4.2. Demonstrates and analyzes the connections between the arts and other content areas.

4.5. Understands how arts knowledge and skills are used in the world of work including careers in the arts.

Unit 9: Design Team**Total Learning Hours for Unit: 23****Performance Assessments:**

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

Students complete one of five design challenges, where they are following the design process to solve a very specific challenge. They are working in groups to create a unique product that meets the challenge. Instructors intentionally minimize students' ability to communicate face-to-face, so students must be creative in how they communicate with each other (this can take many forms, such as Skype, email, Twitter, Facebook, phone calls, paper message, etc. This creates numerous challenges to the students and requires them to utilize many of the 21st Century Skills they have been learning/using in previous activities from this course.

Ultimately, this unit assesses students on their performance in the design challenge. Components that make up this assessment include:

- 1) Team Rubrics
- 2) Teammate Evaluations
- 3) Engineering Notebook Evaluation
- 4) Summary Presentation

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies**Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:**

Cluster: Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. (2.9-12.Z)

Cluster: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

H. Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. (4.9-12.H)

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects. (4.9-12.I)

J. Ethical considerations are important in the development, selection, and use of technologies. (4.9-12.J)

Cluster: Students will develop an understanding of the effects of technology on the environment.

L. Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative effects on the environment. (5.9-12.L)

Cluster: Students will develop an understanding of the attributes of design.

H. The design process includes defining a problem, brainstorming, researching and generating ideas, identifying criteria and specifying constraints, exploring possibilities, selecting an approach, developing a design proposal, making a model or prototype. (8.9-12.H)

I. Design problems are seldom presented in a clearly defined form. (8.9-12.I)

J. The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved. (8.9-12.J)

K. Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other. (8.9-12.K)

Cluster: Students will develop an understanding of engineering design.

I. Established design principles are used to evaluate existing designs, to collect data, and to guide the design process. (9.9-12.I)

J. Engineering design is influenced by personal characteristics, such as creativity, resourcefulness, and the ability to visualize and think abstractly. (9.9-12.J)

K. A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. (9.9-12.K)

L. The process of engineering design takes into account a number of factors. (9.9-12.L)

Cluster: Students will develop the abilities to apply the design process.

M. Identify the design problem to solve and decide whether or not to address it. (11.9-12.M)

N. Identify criteria and constraints and determine how these will affect the design process. (11.9-12.N)

O. Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. (11.9-12.O)

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

Q. Develop and produce a product or system using a design process. (11.9-12.Q)

R. Evaluate final solutions and communicate observation, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models. (11.9-12.R)

Cluster: Students will develop the abilities to use and maintain technological products and systems.

P. Use computers and calculators to access, retrieve, organize, process, maintain, interpret, and evaluate data and information in order to communicate. (12.9-12.P)

Cluster: Students will develop an understanding of and be able to select and use information and communication technologies.

M. Information and communication systems allow information to be transferred from human to human, human to machine, machine to human, and machine to machine. (17.9-12.M)

P. There are many ways to communicate information, such as graphic and electronic means. (17.9-12.P)

Q. Technological knowledge and processes are communicated using symbols, measurement, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli. (17.9-12.Q)

Aligned Washington State Standards

Standards for Mathematical Practice (Common Core State Standards):

Practice 1: Make sense of problems and persevere in solving them.

Practice 2: Reason abstractly and quantitatively.

Practice 3: Construct viable arguments and critique the reasoning of others.

Practice 4: Model with mathematics

Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Apply geometric concepts in modeling situations.

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

Washington Science Standards (Next Generation Science Standards):

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.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):Reading

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

CCRA.R.3 Analyze how and why individuals, events, and ideas develop and interact over the course of a text.

CCRA.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.

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.R.10 Read and comprehend complex literary and informational texts independently and proficiently.

Writing

CCRA.W.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient 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.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

CCRA.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

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

CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

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.

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

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

Language

CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

CCRA.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

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 considering a word or phrase important to comprehension or expression.

Unit 10: Design Challenge

Total Learning Hours for Unit: 33

Performance Assessments:

Performance assessments on the following topics may be developed at the local level. In order to earn approval at the state level, performance assessments must be submitted within this framework.

The culminating project, where students will select a problem that exists in their life/community and generate a solution to this problem, will require students to use almost every single skill from the course.

Working in collaborative teams, students will select a problem facing them, their community, or others. They will then follow the design process to generate a solution to this problem. Students will be assessed on this process the following ways:

- 1) Engineering Notebook
- 2) Design Proposal (which will include a title page, abstract, design brief, technical drawings, hand sketches, disassembly chart, rendered images, and overall summary)
- 3) Group Presentation

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.
- The event, activity, or project and the associated 21st Century Skill should be clearly articulated.
Example: Students will demonstrate the ability to communicate clearly through their group project presentation.

Industry Standards and Competencies

Project Lead the Way Standards - Based on ITEEA Technology Literacy Standards:

Cluster: Students will develop an understanding of the core concepts of technology.

Z. Selecting resources involves trade-offs between competing values, such as availability, cost, desirability, and waste. (2.9-12.Z)

AA. Requirements involve the identification of the criteria and constraints of a product or system and the determination of how they affect the final design and development. (2.9-12.AA)

BB. Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints. (2.9-12.BB)

Cluster: Students will develop an understanding of the attributes of design.

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Practice 5: Use appropriate tools strategically.

Practice 6: Attend to precision.

Practice 7: Look for and make use of structure.

Washington Mathematics Standards (Common Core State Standards):

Cluster: Apply geometric concepts in modeling situations.

G.MG.A.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

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

Washington English Language Arts Standards (Common Core State Standards) - Science and Technology Literacy Standards (Grades 9-10):

RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Washington Science Standards (Next Generation Science Standards):

- 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.

Washington English Language Arts Standards (Common Core State Standards - Anchor Standards):Writing

- CCRA.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- 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.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- CCRA.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening

- 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.
- 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.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- CCRA.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

Language

- CCRA.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
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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 considering a word or phrase important to comprehension or expression.

Washington Arts Standards:

- Arts 2.0 The student demonstrates thinking skills using artistic processes.
- 2.1. Applies a creative process to the arts (dance, music, theatre and visual arts):
- Identifies audience and purpose.
 - Explores, gathers, and interprets information from diverse sources.
 - Uses ideas, foundations, skills and techniques to develop dance, music, theatre and visual art.
 - Implements choices of arts elements, principles, foundations, skills, and techniques in a creative work.
 - Refines work based on feedback, self-reflection, and aesthetic criteria.
 - Presents work to others in a performance, exhibition, and/or production.
- Arts 4.0 The student makes connections within and across the arts to other disciplines, life, cultures and work.
- 4.2. Demonstrates and analyzes the connections between the arts and other content areas.
- 4.3. Understands how the arts impact and reflect personal choices throughout life.

21st Century Skills

Students will demonstrate in this course:

LEARNING & INNOVATION

Creativity and Innovation

- Think Creatively
- Work Creatively with Others
- Implement Innovations

Critical Thinking and Problem Solving

- Reason Effectively
- Use Systems Thinking
- Make Judgments and Decisions
- Solve Problems

Communication and Collaboration

- Communicate Clearly
- Collaborate with Others

INFORMATION, MEDIA & TECHNOLOGY SKILLS

Information Literacy

- Access and Evaluate Information
- Use and Manage Information

Media Literacy

- Analyze Media
- Create Media Products

Information, Communications and Technology (ICT Literacy)

- Apply Technology Effectively

LIFE & CAREER SKILLS

Flexibility and Adaptability

- Adapt to Change
- Be Flexible

Initiative and Self-Direction

- Manage Goals and Time
- Work Independently
- Be Self-Directed Learners

Social and Cross-Cultural

- Interact Effectively with Others
- Work Effectively in Diverse Teams

Productivity and Accountability

- Manage Projects
- Produce Results

Leadership and Responsibility

- Guide and Lead Others
- Be Responsible to Others