



Spokane Public Schools PLTW Introduction to Engineering Design

Course: PLTW Introduction to Engineering Design

Total Framework Hours up to: 180

CIP Code: 149991

Exploratory Preparatory

Date Last Modified: 2/19/2015

Career Cluster: STEM

Cluster Pathway: Engineering and Technology

COMPONENTS AND ASSESSMENTS

Performance Assessments: Work in teams, students will complete two design projects utilizing all steps of the engineering design process, develop solutions and testable prototypes that meet and satisfy specific design requirements, reflect and record ideas for process improvement, use an engineer's notebook as a tool and resource for class notes, activities and projects, and make an oral presentation on five career fields in engineering.

Leadership Alignment:

Work Creatively with Others
Implement Innovations
Make Judgments and Decisions
Communicate Clearly
Collaborate with Others
Access and Evaluate Information
Analyze Media
Create Media Projects
Apply Technology Effectively
Interact Effectively with Others
Work Effectively with Diverse Teams
Manage Projects
Produce Results
Be Responsible to Others

Classroom Focus:

Design Projects and Oral Presentation

Community Focus:

Example: Robotics – Students work in a team environment with fellow students, instructors, mentors, sponsors and robotic administrators. Students effectively communicate with all people involved, provide input and feedback, encourage one another, demonstrate inventiveness, fail often to succeed sooner, follow the Engineering Design Process, in order to contribute to the team and industry.

JFRCR (Journal of FRC Engineering Research)

Example: Robotics – Students analyze and evaluate each other's perspectives, ideas and claims regarding the design and operation of the robot. They draw

conclusions based on tests and researched information and reflect on the results of their chosen solutions.

Example: Robotics – Students use oral, written and nonverbal skills to articulate their thoughts and ideas during the brainstorming, design and build stages. They inform, instruct and motivate each other through the stressful build and competition. Students create posters, signs, flyers, buttons, webpages and videos to share their ideas and success with other robotic teams.

Example: Robotics – Students work effectively with parties to brainstorm, design, build and operate a successful robot. They demonstrate flexibility to compromise and hold themselves and others accountable to accomplish the required goals.

Example: Robotics – Students access information from the Internet using a variety of media in order to self-educate and evaluate the robotic and competition requirements. Students research and keep track of the best information sources in order to proceed effectively through the design and build stages. This information comes from a variety of sources (mentors, sponsors, competition, senior teams, industry and equipment manufacturers).

Example: Robotics – Students research and evaluate possible media tools to post team and robotic progress. Students consider ethical/legal issues when posting information about minors, team's progress/secrets, and responding to other team's posts.

Example: Robotics – Students utilize various media tools to post and document team's progress and performance. This may include posters, brochures, Twitter, Facebook, etc.

Example: Robotics – As stated above, students use a variety of technology to research, communicate, evaluate, organize and program all aspects of the robot and the team's progress and performance

Example: Robotics – Students effectively and professionally interact with various individuals across all cultures, age groups, environments and situations from Kick-off Meetings to team meetings to robotic competitions on College campuses

Example: Robotics – Teams and clubs are made up of diverse individuals from freshman to seniors, teachers to mentors, parents to administrators. Students come from all backgrounds and races with different ideas and perspectives. They work effectively to attain the robotic requirements and goals.

Example: Robotics – Students work to accomplish the goals through the many set-backs and obstacles that occur during the build and competing stages. Students must prioritize their goals and adjust constantly to reach the desired results.

Example: Robotics – Students must attend, plan, design, build, test, evaluate, adjust, present, communicate throughout the entire season to reach the desired results of the robot performance.

Example: Robotics – Students put the interests of the team first in order to accomplish the required results and represent the club and school in a professional manner though all interactions with the community

Standards and Competencies

Unit 1: The Design Process

Competencies

Total Learning Hours for Unit: 16

- Identify and define the terminology used in engineering design and development.
- Identify the steps in an engineering design process and summarize the activities involved in each step of the process.
- Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to gather and interpret information to develop an effective design brief.
- Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution.
- Generate and document multiple ideas or solution paths to a problem through brainstorming.
- Describe the design process used in the solution of a particular problem and reflect on all steps of the design process.

- Justify and validate a problem solution.
- Identify limitations in the design process and the problem solution and recommend possible improvements or caveats.
- Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements.
- Explain the concept of proportion and how it relates to freehand sketching.
- Generate non-technical concept sketches to represent objects or convey design ideas. Organize and express thoughts and information in a clear and concise manner.
- Adjust voice and writing style to align with audience and purpose.
- Support design ideas using a variety of convincing evidence.
- Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design.
- Document information sources using APA format.
- Deliver organized oral presentations of work tailored to the audience.
- Establish objectives for the presentation that are appropriate for the audience.
- Facilitate engaging and purposeful dialog with the audience.
- Create drawings or diagrams as representations of objects, ideas, events, or systems.
- Select and utilize technology (software and hardware) to create high impact visual aids.
- Use presentation software effectively to support oral presentations
- Define and differentiate invention and innovation.
- Assess the development of an engineered product and discuss its impact on society and the environment.
- Identify and differentiate between mechanical, electrical, civil, and chemical engineering fields.
- Demonstrate positive team behaviors and contribute to a positive team dynamic

Aligned Washington State Standards

Speaking & Listening

Comprehension and Collaboration 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.
 - a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
 - b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.
 - c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
 - d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
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.
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.

Presentation of Knowledge and Ideas 11-12

4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.
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.

	6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.
Educational Technology	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
Math	<p>Reason quantitatively and use units to solve problems</p> <p>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>2. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p>
Reading	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
Science	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly</p>

	<p>as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p> <p>INQG: Public communication among scientists is an essential aspect of research. Scientists evaluate the validity of one another's investigations, check the reliability of results, and explain inconsistencies in findings.</p> <p>INQH: Scientists carefully evaluate sources of information for reliability before using that information. When referring to the ideas or findings of others, they cite their sources of information.</p> <p>APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.</p> <p>APPB: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.</p> <p>APPC: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design.</p> <p>APPD: The ability to solve problems is greatly enhanced by use of mathematics and information technologies.</p> <p>APPE: Perfect solutions do not exist. All technological solutions involve trade-offs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not.</p> <p>APPF: It is important for all citizens to apply science and technology to critical issues that influence society.</p> <p>PS1A: Average velocity is defined as a change in position with respect to time. Velocity includes both speed and direction.</p> <p>PS1B: Average acceleration is defined as a change in velocity with respect to time. Acceleration indicates a change in speed and/or a change in direction.</p> <p>PS1C: An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force. (Newton's First Law of Motion, the Law of Inertia)</p> <p>PS1D: A net force will cause an object to accelerate or change direction. A less massive object will speed up more quickly than a more massive object subjected to the same force. (Newton's Second Law of Motion, $F=ma$)</p> <p>PS1E: Whenever one object exerts a force on another object, a force of equal magnitude is exerted on the first object in the opposite direction. (Newton's Third Law of Motion)</p> <p>PS3A: Although energy can be transferred from one object to another and can be transformed from one form of energy to another form, the total energy in a closed system remains the same. The concept of conservation of energy, applies to all physical and chemical changes.</p> <p>PS3B: Kinetic energy is the energy of motion. The kinetic energy of an object is defined by the equation: $E_k = \frac{1}{2} mv^2$</p> <p>PS3C: Gravitational potential energy is due to the separation of mutually attracting masses. Transformations can occur between gravitational potential energy and kinetic energy, but the total amount of energy remains constant.</p>
<p>Writing</p>	<p>1. Write arguments focused on <i>discipline-specific content</i>.</p> <p>a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.</p> <p>b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the</p>

- strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
- c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
 - 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.
 - e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- a. Introduce a topic and 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.
 - 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.
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
 - d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
 - e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing

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

Research to Build and Present Knowledge

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.
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 specific 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.
9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

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

Conventions of Standard English 9-10

1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
 - a. Use parallel structure.*
 - b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
 - a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
 - b. Use a colon to introduce a list or quotation.
 - c. Spell correctly.

Knowledge of Language 9-10

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.

a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use 9-10

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Working individually, students will create a series of freehand technical sketches and drawings that conform to industry standards and reflect the application of three types of pictorial drawings and the application of orthographic project to multiview drawings to interpret and communicate information about real objects.

Leadership Alignment:

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

Classroom Focus:

Freehand sketches and drawing

Community Focus:

Example: Robotics – Students use their prior knowledge and observations to infer if ideas are possible or if they will work to the desired outcome. These ideas are effectively communicated to the team.

Example: Robotics – Students use goal setting and time management techniques to accomplish the robotic requirements within a constricted and stressful timeframe.

Example: Robotics – Students work independently to accomplish assigned tasks without direct supervision. This may include budgeting, documenting expenses, programming, testing, cleaning, inventorying, building, sketching, designing, etc

Example: Robotics – Students research and educate themselves regarding simple machines, wiring, computer programming, software operation, tool operation, etc. This is done outside the meeting/build times and goes above and beyond normal expectations.

Standards and Competencies

Unit 2: Technical Sketching and Drawing

Competencies

Total Learning Hours for Unit: 11

- Generate and document multiple ideas or solution paths to a problem through brainstorming.
- Identify flat patterns (nets) that fold into geometric solid forms.
- Explain the concept of proportion and how it relates to freehand sketching.
- Identify and define technical drawing representations including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Identify line types (including construction lines, object lines, hidden lines, cutting plane lines, section lines, and center lines) used on a technical drawing per ANSI Line Conventions and Lettering Y14.2M-2008 and explain the purpose of each line.
- Determine the minimum number and types of views necessary to fully detail a part.
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Apply tonal shading to enhance the appearance of a pictorial sketch and create a more realistic appearance of a sketched object.
- Hand sketch 1-point and 2-point perspective pictorial views of a simple object or part given the object, a detailed verbal description of the object, a pictorial view of the object, and/or a set of orthographic projections.
- Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.
- Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object.

- Create drawings or diagrams as representations of objects, ideas, events, or systems.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>
Educational Technology	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
Math	<p>Reason quantitatively and use units to solve problems</p> <p>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>2. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</p> <p>Experiment with transformations in the plane</p> <p>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>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).</p>

	<p>3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.</p> <p>4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.</p> <p>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>Understand congruence in terms of rigid motions</p> <p>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>7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.</p> <p>8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.</p> <p>Make geometric constructions</p> <p>12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i></p> <p>13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</p> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <p>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>Apply geometric concepts in modeling situations</p> <p>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.1)</p> <p>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
<p>Reading</p>	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>

<p>Science</p>	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p>
<p>Writing</p>	<ol style="list-style-type: none"> 1. Write arguments focused on <i>discipline-specific content</i>. <ol style="list-style-type: none"> a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 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. e. Provide a concluding statement or section that follows from or supports the argument presented. 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and 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. 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. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). <p>Production and Distribution of Writing</p> <ol style="list-style-type: none"> 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 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. 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. <p>Research to Build and Present Knowledge</p> <ol style="list-style-type: none"> 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. 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 specific 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. 9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

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

Conventions of Standard English 9-10

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

a. Use parallel structure.*

b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

b. Use a colon to introduce a list or quotation.

c. Spell correctly.

Knowledge of Language 9-10

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.

a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use 9-10

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Working individually and in pairs, students will use dial calipers to measure and record the dimensions of an assortment of objects. Use arithmetic and algebra to convert between measurement systems (English, metric, Systems Internationale). Apply linear dimensioning standards to sketch and dimension solid objects. Apply basic statistics to evaluate characteristics of a sample and make inferences about the population and the process that produced the parts. Create spreadsheets and graphs using Excel to depict these statistics and aid in analysis. Sketch well-proportioned objects with dimensions.

Leadership Alignment:

Solve Problems
Collaborate with Others
Apply Technology Effectively

Classroom Focus:

Record, Convert, and Apply Dimensioning

Community Focus:

Example: Robotics – Students work to solve the numerous problems that occur when building a complex system that they have never experienced before. They convey innovative ideas, question each other and mentors to clarify their understanding of the task at hand.

Example: Robotics – Students work effectively with parties to brainstorm, design, build and operate a successful robot. They demonstrate flexibility to compromise and hold themselves and others accountable to accomplish the required goals.

Example: Robotics – As stated above, students use a variety of technology to research, communicate, evaluate, organize and program all aspects of the robot and the team's progress and performance

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Standards and Competencies

Unit 3: Measurement and Statistics

Competencies

Total Learning Hours for Unit: 15

- Define accuracy and precision in measurement.
- Evaluate and compare the accuracy and precision of different measuring devices.
- Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a scale, ruler, or dial caliper and report the measurement using an appropriate level of precision.
- Use units to guide the solution to multi-step problems through dimensional analysis and choose and interpret units consistently in formulas.
- Choose a level of precision and accuracy appropriate to limitations on measurement when reporting quantities.
- Convert quantities between units in the SI and the US Customary measurement systems.
- Convert between different units within the same measurement system including the SI and US Customary measurement systems.
- Identify and define technical drawing representations including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Calculate statistics related to central tendency including mean, median, and mode.
- Represent data with plots on the real number line (e.g., dot plots, histograms, and box plots).
- Use statistics to quantify information, support design decisions, and justify problem solutions.
- Calculate statistics related to variation of data including standard deviation, and range.
- Use a spreadsheet program to store and manipulate raw data.
- Use a spreadsheet program to perform calculations using formulas.
- Use a spreadsheet program to create and display a histogram to represent a set of data.
- Use function tools within a spreadsheet program to calculate statistics for a set of data including mean, median, mode, quartiles, range, and standard deviation.

- Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices.
- Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.
- Identify and correct errors and omissions in the dimensions applied in a technical drawing based on accepted practice and a set of dimensioning rules.
- Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.
- Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object.
- Demonstrate positive team behaviors and contribute to a positive team dynamic.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>Presentation of Knowledge and Ideas 11-12</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
Educational Technology	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p>

	2.4.1 Formulate and synthesize new knowledge.
Math	<p>Reason quantitatively and use units to solve problems</p> <ol style="list-style-type: none"> 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. 2. Define appropriate quantities for the purpose of descriptive modeling. 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. <p>Make geometric constructions</p> <ol style="list-style-type: none"> 12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <ol style="list-style-type: none"> 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>Apply geometric concepts in modeling situations</p> <ol style="list-style-type: none"> 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). 3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost). <p>Summarize, represent, and interpret data on a single count or measurement variable</p> <ol style="list-style-type: none"> 1. Represent data with plots on the real number line (dot plots, histograms, and box plots). 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. 3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). 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, software, or technology to generate data and statistics. <p>Summarize, represent, and interpret data on two categorical and quantitative variables</p> <ol style="list-style-type: none"> 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. 6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. <ol style="list-style-type: none"> a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. <i>Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.</i> b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association. <p>Interpret linear models</p> <ol style="list-style-type: none"> 7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. 8. Compute (using technology) and interpret the correlation coefficient of a linear fit. 9. Distinguish between correlation and causation. <p>Making Inferences and Justifying Conclusions S-IC</p> <p>Understand and evaluate random processes underlying statistical experiments</p> <ol style="list-style-type: none"> 1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population. 2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <i>For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?</i> <p>Make inferences and justify conclusions from sample surveys, experiments and observational studies</p> <ol style="list-style-type: none"> 3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

	<p>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>5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.</p> <p>6. Evaluate reports based on data.</p>
Reading	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
Science	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p> <p>APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.</p>

	<p>APPB: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.</p> <p>APPC: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design.</p> <p>APPD: The ability to solve problems is greatly enhanced by use of mathematics and information technologies.</p> <p>APPE: Perfect solutions do not exist. All technological solutions involve trade-offs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not.</p> <p>APPF: It is important for all citizens to apply science and technology to critical issues that influence society.</p>
<p>Writing</p>	<ol style="list-style-type: none"> 1. Write arguments focused on <i>discipline-specific content</i>. <ol style="list-style-type: none"> a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 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. e. Provide a concluding statement or section that follows from or supports the argument presented. 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and 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. 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. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). <p>Production and Distribution of Writing</p> <ol style="list-style-type: none"> 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 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. 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. <p>Research to Build and Present Knowledge</p> <ol style="list-style-type: none"> 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. 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 specific 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. 9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

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

Conventions of Standard English

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

a. Use parallel structure.

b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

b. Use a colon to introduce a list or quotation.

c. Spell correctly.

Knowledge of Language

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.

a. Write and edit work so that it conforms to the guidelines in a style manual

(e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Working individually, students will apply the design process to create a set of hand sketches to create two solutions to a real problem (Puzzle Cube from scrap wood). Use Autodesk Inventor's 2D Sketch and 3D Modeling tools to create working technical drawings and a virtual assembly of a model that can be tested in virtual simulation. Build a physical model from wooden cubes that have been statistically analyzed for fit within acceptable levels of quality. Accept feedback from others for design improvements to the solution developed. Create a marketing package for the proposed solution

Leadership Alignment:

Reason Effectively

Apply Technology Effectively

Adapt to Change

Be Self-Directed Learners

Manage Projects

Classroom Focus:

Apply the Design Process to a real problem

Community Focus:

Example: Robotics – Students use their prior knowledge and observations to infer if ideas are possible or if they will work to the desired outcome. These ideas are effectively communicated to the team.

Example: Robotics – As stated above, students use a variety of technology to research, communicate, evaluate, organize and program all aspects of the robot and the team's progress and performance

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Example: Robotics – Students take on and assume a variety of roles throughout the design, build and competition stages. Students work in an environment of changing roles, schedules, priorities through tasks and assignments that are not clear and concise.

Example: Robotics – Students research and educate themselves regarding simple machines, wiring, computer programming, software operation, tool operation, etc. This is done outside the meeting/build times and goes above and beyond normal expectations.

Example: Robotics – Students work to accomplish the goals through the many set-backs and obstacles that occur during the build and competing stages. Students must prioritize their goals and adjust constantly to reach the desired results.

<i>Standards and Competencies</i>
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Unit 4: Modeling Skills

Competencies	Total Learning Hours for Unit: 15
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| <ul style="list-style-type: none"> • Describe why physical and virtual models are used to prototype designs before making final production versions. • Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. • Generate and document multiple ideas or solution paths to a problem through brainstorming. • Identify limitations in the design process and the problem solution and recommend possible improvements or caveats. • Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections. • Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object. • Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations. • Use statistics to quantify information, support design decisions, and justify problem solutions. • Represent constraints with equations or inequalities. • Formulate equations and inequalities to represent linear, quadratic, simple rational, and exponential relationships between quantities • Compute (using technology) and interpret the correlation coefficient of a linear fit. • Construct a scatter plot to display bi-variate data, investigate patterns of association, and represent the association with a mathematical model (linear equation) when appropriate. • Explain the term “function” and identify the set of inputs for the function as the domain and the set of outputs from the function as the range. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. • Build a function that describes a relationship between two quantities given a graph, a description of a relationship, or two input-output pairs. • Interpret a function to solve problems in the context of the data. • Interpret the slope (rate of change) and the intercept (constant term) of a linear function in the context of data. • Determine the minimum number and types of views necessary to fully detail a part. • Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings. • Identify and correct errors and omissions in technical drawings including the line work, view selection, view orientation, appropriate scale, and annotations. • Create a set of working drawings to detail a design project. • Fabricate a simple object from technical drawings that may include an isometric view, orthographic projections, and a section view. • Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices. | |
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- Create 3D solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Generate 2D CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice.
- Explain each assembly constraint (mate, flush), its role in an assembly model, and the degrees of freedom that it removes from the movement between parts.
- Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts.
- Manipulate the assembly model to demonstrate the movement. (IPN presentation model)

Aligned Washington State Standards

<p>Speaking & Listening</p>	<ol style="list-style-type: none"> 1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively. <ol style="list-style-type: none"> a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed. c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task. 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. 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>Presentation of Knowledge and Ideas</p> <ol style="list-style-type: none"> 4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks. 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. 6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.
<p>Educational Technology</p>	<ol style="list-style-type: none"> 1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools. 1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities. 1.2.1 Communicate and collaborate to learn with others. 1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures. 1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry. 1.3.2 Locate and organize information from a variety of sources and media. 1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results. 1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions. 2.1.1 Practice personal safety. 2.1.2 Practice ethical and respectful behavior. 2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning. 2.3.1 Select and use common applications.

Math	<p>2.3.2 Select and use online applications. 2.4.1 Formulate and synthesize new knowledge.</p> <p>Reason Quantitatively And Use Units To Solve Problems. 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. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra Creating Equations Create Equations That Describe Numbers Or Relationships Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Reasoning With Equations And Inequalities Solve Equations And Inequalities In One Variable Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. -Represent And Solve Equations And Inequalities Graphically 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).</p> <p>Functions Interpreting Functions Understand The Concept Of A Function And Use Function Notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context Interpret Functions That Arise In Applications In Terms Of The Context 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>Building Functions Build A Function That Models A Relationship Between Two Quantities Determine an explicit expression, a recursive process, or steps for calculation from a context. Linear, Quadratic, And Exponential Models? Interpret Expressions For Functions In Terms Of The Situation They Model Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>Geometry Experiment with transformations in the plane 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. 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). 3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. 4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. 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. Understand congruence in terms of rigid motions 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</p>

	<p>two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.</p> <p>7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.</p> <p>8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.</p> <p>Make geometric constructions</p> <p>12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i></p> <p>13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</p> <p>Circles G-C</p> <p>2. Identify and describe relationships among inscribed angles, radii, and chords. <i>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.</i></p> <p>3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.</p> <p>4. (+) Construct a tangent line from a point outside a given circle to the circle.</p> <p>Find arc lengths and areas of sectors of circles</p> <p>Geometric Measurement and Dimension G-GMD</p> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <p>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>Modeling with Geometry G-MG</p> <p>Apply geometric concepts in modeling situations</p> <p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
<p>Reading</p>	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
<p>Science</p>	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p>
<p>Writing</p>	<ol style="list-style-type: none"> 1. Write arguments focused on <i>discipline-specific content</i>. <ol style="list-style-type: none"> a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 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. e. Provide a concluding statement or section that follows from or supports the argument presented. 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and 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. 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. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). <p>Production and Distribution of Writing</p> <ol style="list-style-type: none"> 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 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.

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.

Research to Build and Present Knowledge

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.

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 specific 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.

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

Range of Writing

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

Conventions of Standard English

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

- Use parallel structure.
- Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

- Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
- Use a colon to introduce a list or quotation.
- Spell correctly.

Knowledge of Language

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.

- Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

- Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
- Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).
- 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, or its etymology.
- 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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Working individually, students will apply knowledge of algebra, geometry and physical science to determine properties of geometric shapes (2D) and solids (3D) including area, surface area, volume, mass, and material density. Create 2D and 3D technical drawings using CAD software of from real objects and pictorial representations.

Leadership Alignment:

Unit 5: Geometry of Design	
Competencies	Total Learning Hours for Unit: 15
<ul style="list-style-type: none"> • Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations. • Construct a scatter plot to display bi-variate data, investigate patterns of association, and represent the association with a mathematical model (linear equation) when appropriate. • Convert between different units within the same measurement system including the SI and US Customary measurement systems. • Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a scale, ruler, or dial caliper and report the measurement using an appropriate level of precision. • Measure mass with accuracy using a scale and report the measurement using an appropriate level of precision. • Measure volume with accuracy and report the measurement with an appropriate level of precision. • Identify three dimensional objects generated by rotations of two-dimensional shapes and vice-versa. • Define the term “physical property” and identify the properties of length, volume, mass, density, surface area, centroid, principle axes, and center of gravity as physical properties. • Solve volume problems using volume formulas for rectangular solids, cylinders, pyramids, cones, and spheres. • Solve real world and mathematical problems involving area and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, right prisms, cylinders, and spheres. • Calculate a physical property indirectly using available data or perform appropriate measurements to gather the necessary data (e.g., determine area or volume using linear measurements or determine density using mass and volume measurements). • Use physical properties to solve design problems (e.g., design an object or structure to satisfy physical constraints or minimize cost). • Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. • Identify types of polygons including a square, rectangle, pentagon, hexagon, and octagon. • Identify and differentiate geometric constructions and constraints such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles. • Identify types of angles including an acute angle, obtuse angle, straight angle, and right angle. • Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints. • Assign a specific material (included in the software library) to a part and use the capabilities of the CAD software to determine the mass, volume, and surface area of an object for which a 3D solid model has been created. • Assign a density value to a new material (not included in the software library) and apply the material to a 3D solid model within CAD software in order to determine the physical properties of the object 	
Aligned Washington State Standards	
Speaking & Listening	<ol style="list-style-type: none"> 1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others’ ideas and expressing their own clearly and persuasively. <ol style="list-style-type: none"> a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed. c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives. d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task. 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. 3. Evaluate a speaker’s point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas,

	<p>word choice, points of emphasis, and tone used.</p> <p>Presentation of Knowledge and Ideas</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
<p>Educational Technology</p>	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems.</p> <p>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>Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra</p> <p>Creating Equations</p> <p>Create Equations That Describe Numbers Or Relationships</p> <p>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>Reasoning With Equations And Inequalities</p> <p>Solve Equations And Inequalities In One Variable</p> <p>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>Represent And Solve Equations And Inequalities Graphically</p> <p>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).</p> <p>Functions</p> <p>Interpreting Functions</p> <p>Understand The Concept Of A Function And Use Function Notation</p> <p>Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context</p> <p>Interpret Functions That Arise In Applications In Terms Of The Context</p>

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.

Building Functions

Build A Function That Models A Relationship Between Two Quantities

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

Linear, Quadratic, And Exponential Models?

Interpret Expressions For Functions In Terms Of The Situation They Model

Interpret the parameters in a linear or exponential function in terms of a context.

Geometry

Experiment with transformations in the plane

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.

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).

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

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

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.

Understand congruence in terms of rigid motions

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.

7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Make geometric constructions

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.*

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

Circles 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.*

3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

4. (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles

Geometric Measurement and Dimension G-GMD

Visualize relationships between two-dimensional and three-dimensional objects

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.

Modeling with Geometry G-MG

Apply geometric concepts in modeling situations

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

	<p>cylinder).</p> <p>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
Reading	<ol style="list-style-type: none"> 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. 2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. 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>Craft and Structure</p> <ol style="list-style-type: none"> 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>. 5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. 6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. <p>Integration of Knowledge and ideas</p> <ol style="list-style-type: none"> 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. 8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. 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. 10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently
Science	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p>
Writing	<ol style="list-style-type: none"> 1. Write arguments focused on <i>discipline-specific content</i>. <ol style="list-style-type: none"> a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the

strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

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.

e. Provide a concluding statement or section that follows from or supports the argument presented.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

a. Introduce a topic and 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.

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.

c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing

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

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.

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.

Research to Build and Present Knowledge

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.

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 specific 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.

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

Range of Writing

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

Conventions of Standard English

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

a. Use parallel structure.

b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

b. Use a colon to introduce a list or quotation.

c. Spell correctly.

Knowledge of Language

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.

a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Working in teams, students will apply the design process to create a poster board display and presentation of a reverse engineered product that includes a visual, functional and structural analysis of the product. Use CAD software to recreate the product parts and complete assembly as technical drawings to include in the portfolio that goes with the board. Present the board to an audience in class and/or at the SMT magnet's Showcase in May. Pass a shop and tool safety test with 100% before disassembling the product in the shop/lab.

Leadership Alignment:

Standards and Competencies**Unit 6: Reverse Engineering****Competencies****Total Learning Hours for Unit: 18**

- Describe the process of reverse engineering. Justify the use of reverse engineering and explain the various reasons to employ reverse engineering, including discovery, documentation, investigation, and product improvement.
- Learn and demonstrate safe dress and practices for the classroom and lab.
- Learn and use relevant safety gear and personal protective equipment (PPE) such as safety glasses.
- Identify and demonstrate appropriate tool selection and application.
- Demonstrate appropriate shop and electronic safety work habits and practices. Create drawings or diagrams as representations of objects, ideas, events, or systems.
- Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.
- Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object.
- Identify and describe the visual principles and elements of design apparent in a natural or man-made object. Define aesthetics and explain how the visual elements and principles of design affect the aesthetics and commercial success of a product.
- Perform a functional analysis of a product in order to determine the purpose, inputs and outputs, and the operation of a product or system. Apply the principles of simple machines to the analysis.
- Perform a structural analysis of a product in order to determine the materials used and the form of component parts as well as the configuration and interaction of component parts when assembled (if applicable).
- Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a scale, ruler, or dial caliper and report the measurement using an appropriate level of precision.
- Measure mass with accuracy using a scale and report the measurement using an appropriate level of precision.

- Assign a specific material (included in the software library) to a part and use the capabilities of the CAD software to determine the mass, volume, and surface area of an object for which a 3D solid model has been created.
- Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Evaluate and compare multiple materials and fastener choices for a product design based on the impact on the design's cost, performance, marketability, environmental impact, and expected service life.
- Determine the minimum number and types of views necessary to fully detail a part.
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Analyze information gathered during reverse engineering to identify shortcoming of the design and/or opportunities for improvement or innovation.
- Organize and express thoughts and information in a clear and concise manner.
- Demonstrate positive team behaviors and contribute to a positive team dynamic.
- Select and utilize technology (software and hardware) to create high impact visual aids.
- Deliver organized oral presentations of work tailored to the audience.
- Adjust voice and writing style to align with audience and purpose.
- Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design
- Write a technical report that documents the reverse engineering process and recommendations for further research & development.
- Apply APA style formatting to the technical report.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>Presentation of Knowledge and Ideas 11-12</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
Educational Technology	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p>

	<p>1.2.1 Communicate and collaborate to learn with others. 1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures. 1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry. 1.3.2 Locate and organize information from a variety of sources and media. 1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results. 1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions. 2.1.1 Practice personal safety. 2.1.2 Practice ethical and respectful behavior. 2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning. 2.3.1 Select and use common applications. 2.3.2 Select and use online applications. 2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems. 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. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra Creating Equations -Create Equations That Describe Numbers Or Relationships Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Reasoning With Equations And Inequalities -Solve Equations And Inequalities In One Variable Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. -Represent And Solve Equations And Inequalities Graphically 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).</p> <p>Functions Interpreting Functions -Understand The Concept Of A Function And Use Function Notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context -Interpret Functions That Arise In Applications In Terms Of The Context 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>Building Functions Build A Function That Models A Relationship Between Two Quantities Determine an explicit expression, a recursive process, or steps for calculation from a context. Linear, Quadratic, And Exponential Models? -Interpret Expressions For Functions In Terms Of The Situation They Model Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>Geometry Experiment with transformations in the plane 1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line,</p>

	<p>distance along a line, and distance around a circular arc.</p> <p>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).</p> <p>3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.</p> <p>4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.</p> <p>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>Understand congruence in terms of rigid motions</p> <p>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>7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.</p> <p>8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.</p> <p>Make geometric constructions</p> <p>12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i></p> <p>13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</p> <p>Circles G-C</p> <p>2. Identify and describe relationships among inscribed angles, radii, and chords. <i>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.</i></p> <p>3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.</p> <p>4. (+) Construct a tangent line from a point outside a given circle to the circle.</p> <p>Find arc lengths and areas of sectors of circles</p> <p>Geometric Measurement and Dimension G-GMD</p> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <p>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>Modeling with Geometry G-MG</p> <p>Apply geometric concepts in modeling situations</p> <p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
<p>Reading</p>	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
<p>Science</p>	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p> <p>INQG: Public communication among scientists is an essential aspect of research. Scientists evaluate the validity of one another’s investigations, check the reliability of results, and explain inconsistencies in findings.</p> <p>INQH: Scientists carefully evaluate sources of information for reliability before using that information. When referring to the ideas or findings of others, they cite their sources of information.</p> <p>APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.</p> <p>APPB: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.</p> <p>APPC: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design.</p> <p>APPD: The ability to solve problems is greatly enhanced by use of mathematics and information technologies.</p> <p>APPE: Perfect solutions do not exist. All technological solutions involve trade-offs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not.</p> <p>APPF: It is important for all citizens to apply science and technology to critical issues that influence society.</p> <p>PS1A: Average velocity is defined as a change in position with respect to time. Velocity includes both speed and direction.</p> <p>PS1B: Average acceleration is defined as a change in velocity with respect to time. Acceleration indicates a change in speed and/or a</p>

	<p>change in direction.</p> <p>PS1C: An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force. (Newton's First Law of Motion, the Law of Inertia)</p> <p>PS1D: A net force will cause an object to accelerate or change direction. A less massive object will speed up more quickly than a more massive object subjected to the same force. (Newton's Second Law of Motion, $F=ma$)</p> <p>PS1E: Whenever one object exerts a force on another object, a force of equal magnitude is exerted on the first object in the opposite direction. (Newton's Third Law of Motion)</p> <p>PS1G: Electrical force is a force of nature independent of gravity that exists between charged objects. Opposite charges attract while like charges repel.</p> <p>PS1H: Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces, and moving magnets produce electric forces.</p> <p>PS3A: Although energy can be transferred from one object to another and can be transformed from one form of energy to another form, the total energy in a closed system remains the same. The concept of conservation of energy, applies to all physical and chemical changes.</p> <p>PS3B: Kinetic energy is the energy of motion. The kinetic energy of an object is defined by the equation: $E_k = \frac{1}{2} mv^2$</p> <p>PS3C: Gravitational potential energy is due to the separation of mutually attracting masses. Transformations can occur between gravitational potential energy and kinetic energy, but the total amount of energy remains constant.</p> <p>PS3D: Waves (including sound, seismic, light, and water waves) transfer energy when they interact with matter. Waves can have different wavelengths, frequencies, and amplitudes, and travel at different speeds.</p>
<p>Writing</p>	<ol style="list-style-type: none"> 1. Write arguments focused on <i>discipline-specific content</i>. <ol style="list-style-type: none"> a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. 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. e. Provide a concluding statement or section that follows from or supports the argument presented. 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. <ol style="list-style-type: none"> a. Introduce a topic and 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. 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. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). <p>Production and Distribution of Writing</p> <ol style="list-style-type: none"> 4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. 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.

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.

Research to Build and Present Knowledge

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.

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 specific 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.

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

Range of Writing

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

Conventions of Standard English

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

a. Use parallel structure.

b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

b. Use a colon to introduce a list or quotation.

c. Spell correctly.

Knowledge of Language

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.

a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

COMPONENTS AND ASSESSMENTS

Performance Assessments:

Working as a team, students will write a design brief to communicate the problem, problem constraints, and solution criteria; write a technical report that documents the reverse engineering process and with detailed and documented recommendations for an improvement in form, fit or function. Correctly apply APA style formatting to the technical report.

Leadership Alignment:

Standards and Competencies

Unit 7: Documentation

Competencies

Total Learning Hours for Unit: 25

- Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design.
- Analyze information gathered during reverse engineering to identify shortcoming of the design and/or opportunities for improvement or innovation.
- Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to validate design decisions and justify a problem solution.
- Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution.
- Write a design brief to communicate the problem, problem constraints, and solution criteria.
- Generate and document multiple ideas or solution paths to a problem through brainstorming.
- Jointly develop a decision matrix based on accepted outcome criteria and constraints. Clearly justify and validate a selected solution path.
- Design a testable prototype the chosen solution using CAD software.
- Complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements.
- Describe the design process used in the solution of a particular problem and reflect on all steps of the design process.
- Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders.
- Support design ideas using a variety of convincing evidence.
- Hand sketch a scaled full or half section view in the correct orientation to fully detail an object or part given the actual object, a detailed verbal description of the object, a pictorial view of the object or a set of orthographic projections.
- Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial an isometric view of the object.
- Create a set of working drawings to detail a design project.
- Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc.
- Define and determine the specified dimension, tolerance, upper limit, and lower limit for any given dimension and related tolerance (or any distance that is dependent on given dimensions) shown on a technical drawing.
- Determine the allowance between two mating parts of an assembly based on dimensions given on a technical drawing.
- Differentiate between clearance and interference fit and identify the type of fit given a drawing, a description, or a physical example of two mating parts.
- Analyze the performance of a design during virtual testing using CAD software and judge the solution as viable or non-viable with respect to meeting the design requirements.
- Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices.
- Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations.
- Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.
- Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes.
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as

- necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Dimension and annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice.
- Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement.
- Represent constraints with equations or inequalities.
- Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.
- Organize and express thoughts and information in a clear and concise manner.
- Adjust voice and writing style to align with audience and purpose.
- Create a technical report according to the American National Standards Institute (ANSI) technical report layout and format specifics.
- Demonstrate positive team behaviors and contribute to a positive team dynamic.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others' ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>Presentation of Knowledge and Ideas</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
Educational Technology	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p>

	<p>2.1.2 Practice ethical and respectful behavior. 2.2.1 Develop skills to use technology effectively. 2.2.2 Use a variety of hardware to support learning. 2.3.1 Select and use common applications. 2.3.2 Select and use online applications. 2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems. 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. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra Creating Equations -Create Equations That Describe Numbers Or Relationships Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Reasoning With Equations And Inequalities -Solve Equations And Inequalities In One Variable Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. -Represent And Solve Equations And Inequalities Graphically 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).</p> <p>Functions Interpreting Functions -Understand The Concept Of A Function And Use Function Notation Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context -Interpret Functions That Arise In Applications In Terms Of The Context 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>Building Functions Build A Function That Models A Relationship Between Two Quantities Determine an explicit expression, a recursive process, or steps for calculation from a context. Linear, Quadratic, And Exponential Models Interpret Expressions For Functions In Terms Of The Situation They Model Interpret the parameters in a linear or exponential function in terms of a context.</p> <p>Geometry Experiment with transformations in the plane 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. 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). 3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. 4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.</p>

	<p>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>Understand congruence in terms of rigid motions</p> <p>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>7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.</p> <p>8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.</p> <p>Make geometric constructions</p> <p>12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>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.</i></p> <p>13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.</p> <p>Circles G-C</p> <p>2. Identify and describe relationships among inscribed angles, radii, and chords. <i>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.</i></p> <p>3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.</p> <p>4. (+) Construct a tangent line from a point outside a given circle to the circle.</p> <p>Find arc lengths and areas of sectors of circles</p> <p>Geometric Measurement and Dimension G-GMD</p> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <p>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>Modeling with Geometry G-MG</p> <p>Apply geometric concepts in modeling situations</p> <p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
<p>Reading</p>	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
<p>Science</p>	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p> <p>INQG: Public communication among scientists is an essential aspect of research. Scientists evaluate the validity of one another's investigations, check the reliability of results, and explain inconsistencies in findings.</p> <p>INQH: Scientists carefully evaluate sources of information for reliability before using that information. When referring to the ideas or findings of others, they cite their sources of information.</p> <p>APPA: Science affects society and cultures by influencing the way many people think about themselves, others, and the environment. Society also affects science by its prevailing views about what is important to study and by deciding what research will be funded.</p> <p>APPB: The technological design process begins by defining a problem in terms of criteria and constraints, conducting research, and generating several different solutions.</p> <p>APPC: Choosing the best solution involves comparing alternatives with respect to criteria and constraints, then building and testing a model or other representation of the final design.</p> <p>APPD: The ability to solve problems is greatly enhanced by use of mathematics and information technologies.</p> <p>APPE: Perfect solutions do not exist. All technological solutions involve trade-offs in which decisions to include more of one quality means less of another. All solutions involve consequences, some intended, others not.</p> <p>APPF: It is important for all citizens to apply science and technology to critical issues that influence society.</p> <p>PS1A: Average velocity is defined as a change in position with respect to time. Velocity includes both speed and direction.</p> <p>PS1B: Average acceleration is defined as a change in velocity with respect to time. Acceleration indicates a change in speed and/or a change in direction.</p> <p>PS1C: An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion at constant velocity will continue at the same velocity unless acted on by an unbalanced force. (Newton's First Law of Motion, the Law of Inertia)</p> <p>PS1D: A net force will cause an object to accelerate or change direction. A less massive object will speed up more quickly than a more massive object subjected to the same force. (Newton's Second Law of Motion, $F=ma$)</p> <p>PS1E: Whenever one object exerts a force on another object, a force of equal magnitude is exerted on the first object in the opposite direction. (Newton's Third Law of Motion)</p>

	<p>PS3A: Although energy can be transferred from one object to another and can be transformed from one form of energy to another form, the total energy in a closed system remains the same. The concept of conservation of energy, applies to all physical and chemical changes.</p> <p>PS3B: Kinetic energy is the energy of motion. The kinetic energy of an object is defined by the equation: $E_k = \frac{1}{2} mv^2$</p>
<p>Writing</p>	<p>1. Write arguments focused on <i>discipline-specific content</i>.</p> <p>a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.</p> <p>b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.</p> <p>c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.</p> <p>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>e. Provide a concluding statement or section that follows from or supports the argument presented.</p> <p>2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>a. Introduce a topic and 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.</p> <p>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.</p> <p>c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.</p> <p>d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.</p> <p>e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).</p> <p>Production and Distribution of Writing</p> <p>4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>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.</p> <p>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.</p> <p>Research to Build and Present Knowledge</p> <p>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.</p> <p>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 specific 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.</p> <p>9. Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>Range of Writing</p> <p>10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p> <p>Language Standards</p> <p>Conventions of Standard English</p>

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| | <ol style="list-style-type: none">1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.<ol style="list-style-type: none">a. Use parallel structure.*b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.<ol style="list-style-type: none">a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.b. Use a colon to introduce a list or quotation.c. Spell correctly. <p>Knowledge of Language</p> <ol style="list-style-type: none">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.<ol style="list-style-type: none">a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., <i>APA Style</i>) appropriate for the discipline and writing type. <p>Vocabulary Acquisition and Use</p> <ol style="list-style-type: none">4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on <i>grades 9–10 reading and content</i>, choosing flexibly from a range of strategies.<ol style="list-style-type: none">a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., <i>analyze, analysis, analytical; advocate, advocacy</i>).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, or its etymology.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). |
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COMPONENTS AND ASSESSMENTS

Performance Assessments:

Working individually, students will use a set of existing documentation to create a print and digital portfolio of technical working drawings, assembly instructions and animations that conform to industry standards. Use of parametric equations is required. Apply engineering change orders to previously completed work and make adaptive changes.

Leadership Alignment:

Standards and Competencies

Unit 8: Advanced Computer Modeling

Competencies

Total Learning Hours for Unit: 15

- Create technical drawings or diagrams as representations of objects, ideas, events, or systems.
- Formulate equations and inequalities to represent linear, relationships between quantities.
- Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations.
- Formulate equations and inequalities to represent linear, relationships between quantities.
- Identify limitations in the design process and the problem solution and recommend possible improvements or caveats.
- Identify and differentiate geometric constructions and constraints such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles.
- Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Determine the minimum number and types of views necessary to fully detail a part
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc.
- Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices.
- Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.
- Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes.
- Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance.
- Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Create relationships among part features and dimensions using parametric formulas.
- Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement.
- Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.
- Create an exploded view of a given assembly. Identify each component of the assembly with identification numbers, and create a parts list to detail each component using CAD.

Aligned Washington State Standards

Speaking & Listening

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.
 - a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
 - b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.

	<p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>Presentation of Knowledge and Ideas 11-12</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
<p>Educational Technology</p>	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems. 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. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra Creating Equations -Create Equations That Describe Numbers Or Relationships Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>Reasoning With Equations And Inequalities -Solve Equations And Inequalities In One Variable Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. -Represent And Solve Equations And Inequalities Graphically</p>

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).

Functions

Interpreting Functions

-Understand The Concept Of A Function And Use Function Notation

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

-Interpret Functions That Arise In Applications In Terms Of The Context

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.

Building Functions

Build A Function That Models A Relationship Between Two Quantities

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

Linear, Quadratic, And Exponential Models?

-Interpret Expressions For Functions In Terms Of The Situation They Model

Interpret the parameters in a linear or exponential function in terms of a context.

Geometry

Experiment with transformations in the plane

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.

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).

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

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

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.

Understand congruence in terms of rigid motions

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.

7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Make geometric constructions

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.*

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

Circles 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.*

3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

4. (+) Construct a tangent line from a point outside a given circle to the circle.

	<p>Find arc lengths and areas of sectors of circles</p> <p>Geometric Measurement and Dimension G-GMD</p> <p>Visualize relationships between two-dimensional and three-dimensional objects</p> <p>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>Modeling with Geometry G-MG</p> <p>Apply geometric concepts in modeling situations</p> <p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
<p>Reading</p>	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
<p>Science</p>	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p>

	<p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions. INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p>
<p>Writing</p>	<p>1. Write arguments focused on <i>discipline-specific content</i>.</p> <p>a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.</p> <p>b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience’s knowledge level, concerns, values, and possible biases.</p> <p>c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.</p> <p>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>e. Provide a concluding statement or section that follows from or supports the argument presented.</p> <p>2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</p> <p>a. Introduce a topic and 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.</p> <p>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.</p> <p>c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.</p> <p>d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.</p> <p>e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).</p> <p>Production and Distribution of Writing</p> <p>4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</p> <p>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.</p> <p>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.</p> <p>Research to Build and Present Knowledge</p> <p>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.</p> <p>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 specific 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.</p> <p>9. Draw evidence from informational texts to support analysis, reflection, and research.</p> <p>Range of Writing</p> <p>10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.</p> <p>Conventions of Standard English</p> <p>1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.</p>

- a. Use parallel structure.
 - b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
2. Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
- a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
 - b. Use a colon to introduce a list or quotation.
 - c. Spell correctly.
- Knowledge of Language**
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.
- a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.
- Vocabulary Acquisition and Use**
4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.
- a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word’s position or function in a sentence) as a clue to the meaning of a word or phrase.
 - b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).
 - 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, or its etymology.
 - 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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: As a member of a design team, students will complete the design and presentation of a new product by following the design process. Create a complete set of technical drawings complete with proper dimensions and tolerances. Follow the design process. Work as a member of a virtual design team to complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. Make an oral presentation of final design and the process used in its development. Contribute to peer evaluation for continuous improvement of team work.

Leadership Alignment:

- Think Creatively
- Use Systems Thinking
- Communicate Clearly
- Collaborate with Others
- Access and Evaluate Information
- Produce Results
- Guide and Lead Others

Classroom Focus:

Design Project and Presentation

Community Focus:

JFRCR (Journal of FRC Engineering Research)

Example: Robotics – Students work as a team with engineering and mechanical mentors to brainstorm possible solutions to design and develop a robot to perform specific tasks. Solutions must be wildly creative in order to compete in regional events. Students will work through many design iterations, analyzing, evaluating and refining their ideas until a final prototype is built.

Example: Robotics – Students consider, design, test, analyze and evaluate how a robot’s sub-systems interact with each other to produce the overall effectiveness of the robot.

Example: Robotics – Students use oral, written and nonverbal skills to articulate their thoughts and ideas during the brainstorming, design and build stages. They inform, instruct and motivate each other through the stressful build and competition. Students create posters, signs, flyers, buttons, webpages and videos to share their ideas and success with other robotic teams.

Example: Robotics – Students work effectively with parties to brainstorm, design, build and operate a successful robot. They demonstrate flexibility to compromise and hold themselves and others accountable to accomplish the required goals.

Example: Robotics – Students access information from the Internet using a variety of media in order to self-educate and evaluate the robotic and competition requirements. Students research and keep track of the best information sources in order to proceed effectively through the design and build stages. This information comes from a variety of sources (mentors, sponsors, competition, senior teams, industry and equipment manufacturers).

Example: Robotics – Students must attend, plan, design, build, test, evaluate, adjust, present, communicate throughout the entire season to reach the desired results of the robot performance.

Example: Robotics – Senior Robotic Students guide and lead freshman students throughout the season. They also work to help competing teams and sister-teams throughout the build and competing stages – Gracious Professionalism

Standards and Competencies

Unit 9: Design Challenge & Teams

Competencies

Total Learning Hours for Unit: 20

- Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders.
- Explain design requirements and function claims using STEM principles and practices.
- Generate and document multiple ideas or solution paths to a problem through brainstorming.
- Write a design brief to communicate the problem, problem constraints, and solution criteria.
- Assess the development of an engineered product and discuss its impact on society and the environment.
- Identify and describe the steps of a typical product lifecycle (including raw material extraction, processing, manufacture, use and maintenance, and disposal).
- Identify and explain how the basic theories of ethics relate to engineering.
- Jointly develop a decision matrix based on accepted outcome criteria and constraints. Use a decision matrix to evaluate and compare multiple design solutions in order to select a solution path that satisfies the design requirements
- Create and utilize a Gantt chart to plan, monitor, and control task completion during a design project.
- Identify an appropriate mode of two-way communication based on the audience and intended goal of the communication.
- Identify team member skill sets needed to produce an effective team.
- Identify and assign team member roles.
- Define the term group norms and discuss the importance of norms in creating an effective team environment.
- Identify strategies to resolve team conflict.
- Demonstrate positive team behaviors and contribute to a positive team dynamic.
- Establish common goals, equitable workloads, accountability, and create a set of team norms.
- Contribute equitably to the attainment of group goals based on assigned roles.
- Practice appropriate conflict resolution strategies within a team environment.
- Identify appropriate technology to support remote collaboration among virtual design team members (such as asynchronous communications, audio and video conferencing, instant messaging, synchronous file editing, and file transfer).
- Create technical drawings or diagrams as representations of objects, ideas, events, or systems.

- Formulate equations and inequalities to represent linear, relationships between quantities.
- Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations.
- Formulate equations and inequalities to represent linear, relationships between quantities.
- Identify limitations in the design process and the problem solution and recommend possible improvements or caveats.
- Identify and differentiate geometric constructions and constraints such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles.
- Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Determine the minimum number and types of views necessary to fully detail a part
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc.
- Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices.
- Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.
- Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes.
- Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance.
- Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Create relationships among part features and dimensions using parametric formulas.
- Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement.
- Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.
- Create an exploded view of a given assembly. Identify each component of the assembly with identification numbers, and create a parts list to detail each component using CAD.
- Use an appropriate and professional tone and vernacular based on the audience of email/online correspondence.
- Document correspondence and conversations in an accurate and organized manner
- Review and evaluate the written work of peers and make recommendations for improvement.
- Select and utilize technology (software and hardware) to create high impact visual aids.
- Select and utilize videos and images from CAD software to convey information appropriate for the given audience.
- Deliver organized oral presentations of work tailored to the audience.
- Use presentation software effectively to support oral presentations.
- Establish objectives for the presentation that are appropriate for the audience.
- Deliver organized oral presentations of work tailored to the audience.
- Facilitate engaging and purposeful dialog with the audience.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve</p>
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	<p>contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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>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>Presentation of Knowledge and Ideas 11-12</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
<p>Educational Technology</p>	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems.</p> <p>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>Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra</p> <p>Creating Equations</p> <p>-Create Equations That Describe Numbers Or Relationships</p> <p>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>Reasoning With Equations And Inequalities</p> <p>Solve Equations And Inequalities In One Variable</p> <p>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>Represent And Solve Equations And Inequalities Graphically</p> <p>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).</p> <p>Functions</p>

Interpreting Functions

Understand The Concept Of A Function And Use Function Notation

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

Interpret Functions That Arise In Applications In Terms Of The Context

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.

Building Functions

Build A Function That Models A Relationship Between Two Quantities

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

Linear, Quadratic, And Exponential Models?

Interpret Expressions For Functions In Terms Of The Situation They Model

Interpret the parameters in a linear or exponential function in terms of a context.

Geometry

Experiment with transformations in the plane

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.
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).
3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
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.

Understand congruence in terms of rigid motions

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.
7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Make geometric constructions

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.*
13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Circles 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.*
3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
4. (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles

Geometric Measurement and Dimension G-GMD

Visualize relationships between two-dimensional and three-dimensional objects

	<p>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>Modeling with Geometry G-MG Apply geometric concepts in modeling situations</p> <p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
Reading	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
Science	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p>

Writing

1. Write arguments focused on *discipline-specific content*.
 - a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
 - b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
 - c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
 - 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.
 - e. Provide a concluding statement or section that follows from or supports the argument presented.
 2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
 - a. Introduce a topic and 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.
 - 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.
 - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
 - d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
 - e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).
- Production and Distribution of Writing**
4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
 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.
 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.
- Research to Build and Present Knowledge**
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.
 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 specific 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.
 9. Draw evidence from informational texts to support analysis, reflection, and research.
- Range of Writing**
10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
- Language Standards**
- Conventions of Standard English**
1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
 - a. Use parallel structure.
 - b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent,

dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

- Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
- Use a colon to introduce a list or quotation.
- Spell correctly.

Knowledge of Language

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.

- Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

- Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word’s position or function in a sentence) as a clue to the meaning of a word or phrase.
- Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).
- 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, or its etymology.
- 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).

COMPONENTS AND ASSESSMENTS

Performance Assessments: Participating on a virtual team, students will use remote collaboration tools to support team collaboration and problem solving. Work as a member of a virtual design team to complete a design project utilizing all steps of a design process, and find a solution that meets specific design requirements. Make an oral presentation of final design and the process used in its development. Contribute to peer evaluation for continuous improvement of team work.

Leadership Alignment:

Use Systems Thinking
 Communicate Clearly
 Collaborate with Others
 Access and Evaluate Information
 Use and Manage Information
 Produce Results
 Guide and Lead Others

Classroom Focus:

Virtual Design Team Project

Community Focus:

Example: Robotics – Students consider, design, test, analyze and evaluate how a robot’s sub-systems interact with each other to produce the overall effectiveness of the robot.

JFRCR (Journal of FRC Engineering Research)

Example: Robotics – Students use oral, written and nonverbal skills to articulate their thoughts and ideas during the brainstorming, design and build stages. They inform, instruct and motivate each other through the stressful build and competition. Students create posters, signs, flyers, buttons, webpages and videos to share their ideas and success with other robotic teams.

Example: Robotics – Students work effectively with parties to brainstorm, design, build and operate a successful robot. They demonstrate flexibility to compromise and hold themselves and others accountable to accomplish the required goals.

Example: Robotics – Students access information from the Internet using a variety of media in order to self-educate and evaluate the robotic and competition requirements. Students research and keep track of the best information sources in order to proceed effectively through the design and build stages. This information comes from a variety of sources (mentors, sponsors, competition, senior teams, industry and equipment manufacturers).

Example: Robotics – Students manage and document the updated information throughout the build stage in order to keep up on the continual changes to the requirements, hardware and software upgrades

Example: Robotics – Students must attend, plan, design, build, test, evaluate, adjust, present, communicate throughout the entire season to reach the desired results of the robot performance.

Example: Robotics – Senior Robotic Students guide and lead freshman students throughout the season. They also work to help competing teams and sister-teams throughout the build and competing stages – Gracious Professionalism

Standards and Competencies

Unit 10: Virtual Design Team

Competencies

Total Learning Hours for Unit: 30

- Define and justify a design problem, and express the concerns, needs, and desires of the primary stakeholders.
- Explain design requirements and function claims using STEM principles and practices.
- Generate and document multiple ideas or solution paths to a problem through brainstorming.
- Write a design brief to communicate the problem, problem constraints, and solution criteria.
- Assess the development of an engineered product and discuss its impact on society and the environment.
- Identify and describe the steps of a typical product lifecycle (including raw material extraction, processing, manufacture, use and maintenance, and disposal).
- Identify and explain how the basic theories of ethics relate to engineering.
- Jointly develop a decision matrix based on accepted outcome criteria and constraints. Use a decision matrix to evaluate and compare multiple design solutions in order to select a solution path that satisfies the design requirements
- Create and utilize a Gantt chart to plan, monitor, and control task completion during a design project.
- Identify an appropriate mode of two-way communication based on the audience and intended goal of the communication.
- Identify team member skill sets needed to produce an effective team.
- Identify and assign team member roles.
- Define the term group norms and discuss the importance of norms in creating an effective team environment.
- Identify strategies to resolve team conflict.
- Demonstrate positive team behaviors and contribute to a positive team dynamic.
- Establish common goals, equitable workloads, accountability, and create a set of team norms.
- Contribute equitably to the attainment of group goals based on assigned roles.
- Practice appropriate conflict resolution strategies within a team environment.
- Identify appropriate technology to support remote collaboration among virtual design team members (such as asynchronous communications, audio and video conferencing, instant messaging, synchronous file editing, and file transfer).
- Create technical drawings or diagrams as representations of objects, ideas, events, or systems.
- Formulate equations and inequalities to represent linear, relationships between quantities.
- Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations.
- Formulate equations and inequalities to represent linear, relationships between quantities.
- Identify limitations in the design process and the problem solution and recommend possible improvements or caveats.

- Identify and differentiate geometric constructions and constraints such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles.
- Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, perspective, auxiliary, and section views.
- Determine the minimum number and types of views necessary to fully detail a part
- Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.
- Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertains to information presented on the entire drawing (such as units, scale, patent details, etc.
- Dimension orthographic projections and section views of simple objects or parts according to a set of dimensioning standards and accepted practices.
- Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing.
- Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes.
- Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance.
- Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.
- Generate CAD multi-view technical drawings, including orthographic projections, sections view(s), detail view(s), auxiliary view(s) and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a part according to standard engineering practice.
- Create relationships among part features and dimensions using parametric formulas.
- Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement.
- Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.
- Create an exploded view of a given assembly. Identify each component of the assembly with identification numbers, and create a parts list to detail each component using CAD.
- Use an appropriate and professional tone and vernacular based on the audience of email/online correspondence.
- Document correspondence and conversations in an accurate and organized manner
- Review and evaluate the written work of peers and make recommendations for improvement.
- Select and utilize technology (software and hardware) to create high impact visual aids.
- Select and utilize videos and images from CAD software to convey information appropriate for the given audience.
- Deliver organized oral presentations of work tailored to the audience.
- Use presentation software effectively to support oral presentations.
- Establish objectives for the presentation that are appropriate for the audience.
- Deliver organized oral presentations of work tailored to the audience.
- Facilitate engaging and purposeful dialog with the audience.

Aligned Washington State Standards

Speaking & Listening	<p>1. Initiate and participate effectively in a range of collaborative discussions (one-on- one, in groups, and teacher-led) with diverse partners on <i>grades 11–12 topics, texts, and issues</i>, building on others’ ideas and expressing their own clearly and persuasively.</p> <p>a. Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p> <p>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</p> <p>c. Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.</p> <p>d. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.</p> <p>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</p>
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	<p>data.</p> <p>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>Presentation of Knowledge and Ideas</p> <p>4. Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.</p> <p>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.</p> <p>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate.</p>
<p>Educational Technology</p>	<p>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</p> <p>1.1.2 Use models and simulations to explore systems, identify trends and forecast possibilities.</p> <p>1.2.1 Communicate and collaborate to learn with others.</p> <p>1.2.2 Develop cultural understanding and global awareness by engaging with learners of many cultures.</p> <p>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</p> <p>1.3.2 Locate and organize information from a variety of sources and media.</p> <p>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</p> <p>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</p> <p>2.1.1 Practice personal safety.</p> <p>2.1.2 Practice ethical and respectful behavior.</p> <p>2.2.1 Develop skills to use technology effectively.</p> <p>2.2.2 Use a variety of hardware to support learning.</p> <p>2.3.1 Select and use common applications.</p> <p>2.3.2 Select and use online applications.</p> <p>2.4.1 Formulate and synthesize new knowledge.</p>
<p>Math</p>	<p>Reason Quantitatively And Use Units To Solve Problems.</p> <p>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. Define appropriate quantities for the purpose of descriptive modeling.</p> <p>Algebra</p> <p>Creating Equations</p> <p>Create Equations That Describe Numbers Or Relationships</p> <p>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</p> <p>Reasoning With Equations And Inequalities</p> <p>Solve Equations And Inequalities In One Variable</p> <p>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</p> <p>-Represent And Solve Equations And Inequalities Graphically</p> <p>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).</p> <p>Functions</p> <p>Interpreting Functions</p> <p>Understand The Concept Of A Function And Use Function Notation</p> <p>Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context</p>

Interpret Functions That Arise In Applications In Terms Of The Context

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.

Building Functions

Build A Function That Models A Relationship Between Two Quantities

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

Linear, Quadratic, And Exponential Models

Interpret Expressions For Functions In Terms Of The Situation They Model

Interpret the parameters in a linear or exponential function in terms of a context.

Geometry

Experiment with transformations in the plane

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.
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).
3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
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.

Understand congruence in terms of rigid motions

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.
7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Make geometric constructions

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.*

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

Circles 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.*

3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

4. (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles

Geometric Measurement and Dimension G-GMD

Visualize relationships between two-dimensional and three-dimensional objects

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.

Modeling with Geometry G-MG

- Apply geometric concepts in modeling situations

	<p>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>3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize</p>
Reading	<p>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>2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</p> <p>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>Craft and Structure</p> <p>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>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</p> <p>6. Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</p> <p>Integration of Knowledge and ideas</p> <p>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>8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.</p> <p>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>10. By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently</p>
Science	<p>SYSA: Feedback is a process in which the output of a system provides information used to regulate the operation of the system. Positive feedback increases the disturbance to a system. Negative feedback reduces the disturbance to a system.</p> <p>SYSB: Systems thinking can be especially useful in analyzing complex situations. To be useful, a system needs to be specified as clearly as possible.</p> <p>SYSC: In complex systems, entirely new and unpredictable properties may emerge. Consequently, modeling a complex system in sufficient detail to make reliable predictions may not be possible.</p> <p>SYSD Systems can be changing or in equilibrium.</p> <p>INQA: Scientists generate and evaluate questions to investigate the natural world.</p> <p>INQB: Scientific progress requires the use of various methods appropriate for answering different kinds of research questions, a thoughtful plan for gathering data needed to answer the question, and care in collecting, analyzing, and displaying the data.</p> <p>INQC: Conclusions must be logical, based on evidence, and consistent with prior established knowledge.</p> <p>INQD: The methods and procedures that scientists use to obtain evidence must be clearly reported to enhance opportunities for further investigation.</p> <p>INQE: essence of scientific investigation involves the development of a theory or conceptual model that can generate testable predictions.</p> <p>INQF: Science is a human endeavor that involves logical reasoning and creativity and entails the testing, revision, and occasional discarding of theories as new evidence comes to light.</p>
Writing	<p>1. Write arguments focused on <i>discipline-specific content</i>.</p> <p>a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.</p> <p>b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the</p>

strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

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.

e. Provide a concluding statement or section that follows from or supports the argument presented.

2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

a. Introduce a topic and 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.

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.

c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.

e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).

Production and Distribution of Writing

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

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.

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.

Research to Build and Present Knowledge

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.

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 specific 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.

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

Range of Writing

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

Conventions of Standard English

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

a. Use parallel structure.*

b. Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.

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

a. Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.

b. Use a colon to introduce a list or quotation.

c. Spell correctly.

Knowledge of Language

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.

a. Write and edit work so that it conforms to the guidelines in a style manual (e.g., *APA Style*) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on *grades 9–10 reading and content*, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., *analyze, analysis, analytical; advocate, advocacy*).

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, or its etymology.

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).

21st Century Skills

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