



## Spokane Public Schools Civil Engineering and Architecture

<b>Course: Civil Engineering and Architecture</b>	<b>Total Framework Hours: 180</b>
<b>CIP Code: 150201</b> <input type="checkbox"/> Exploratory <input checked="" type="checkbox"/> Preparatory	<b>Date Last Modified: June 2015</b>
<b>Career Cluster: Science, Technology, Engineering and Mathematics</b>	<b>Cluster Pathway: Science &amp; Math</b>

### COMPONENTS AND ASSESSMENTS

#### Performance Assessments:

- Connect modern structural and architectural designs to historical architectural and civil engineering achievements.
- Identify three general categories of structural systems used in historical buildings.
- Explain how historical innovations have contributed to the evolution of civil engineering and architecture.
- Identify and explain the application of principles and elements of design to architectural buildings.
- Determine architectural style through identification of building features, components, and materials.
- Create a mock-up model depicting an architectural style or feature using a variety of materials.
- Identify the primary duties, and attributes of a civil engineer and an architect along with the traditional path for becoming a civil engineer or architect.
- Identify various specialty disciplines associated with civil engineering.
- Participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.
- Understand the relationship among the stakeholders involved in the design and construction of a building project.

#### Leadership Alignment:

##### Classroom Focus:

- Work in groups to create a mock-up model solution to a community problem that can be addressed through engineering and architectural design depicting an architectural style or feature using a variety of materials.
- Participate in a design charrette and recognize/leverage the value of using a charrette to develop innovative solutions to support whole building design.

This is an ongoing cumulative community solutions project that is completed throughout the course and culminates in completion and installation. Future project may focus on continuously improving existing projects or may be new solutions.

##### Community Focus:

- Research a community problem that can be resolved through an architecturally designed solution
- Select a neighborhood to implement solutions
- Meet with neighborhood client and community partners to brainstorm solutions

Think Creatively: Use a wide range of idea creation techniques (such as brainstorming)

Think Creatively: Create new and worthwhile ideas (both incremental and radical concepts)

Think Creatively: Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others: Develop, implement and communicate new ideas to others effectively.

Work Creatively with Others: Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.

Work Creatively with Others: Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas.

Work Creatively with Others: View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

Implement Innovations: Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur.

Reason Effectively: Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking: Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Collaborate with Others: Demonstrate ability to work effectively and respectfully with diverse teams.

Collaborate with Others: Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal.

Collaborate with Others: Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

Apply Technology Effectively: Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

Manage Goals and Time: Utilize time and manage workload efficiently.

Work Independently: Monitor, define, prioritize and complete tasks without direct oversight.

Be Self-directed Learners: Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise.

Manage Projects: Set and meet goals, even in the face of obstacles and competing pressures.

Manage Projects: Prioritize, plan and manage work to achieve the intended result.

Interact effectively with others

Work effectively in diverse teams – especially to leverage social and cultural differences to create new ideas and increase both innovation and quality of work

***Standards and Competencies***

**Standard/Unit: Overview of Civil Engineering and Architecture**

**Competencies**

**Total Learning Hours for Unit: 23**

**History of Civil Engineering and Architecture**

- Many features of ancient structures are seen in modern buildings.
- Architectural style is often an important key to understanding how a community or neighborhood has developed and the aesthetic customs that have formed over time.
- The multiple architectural styles that have been developed throughout history are an indication of changing needs of people and society and uses for space.
- Visual design principles and elements constitute an aesthetic vocabulary that can be used to describe buildings and may contribute to their function, location, or time period.

**Careers in Civil Engineering and Architecture**

- Civil engineers and architects apply math, science, and discipline-specific skills to design and implement solutions.
- Civil engineering and architecture careers are comprised of several specialties and offer creative job opportunities for individuals with a wide variety of backgrounds and goals.
- Civil engineers are problem solvers involved in the design and construction of a diverse array of projects in a wide range of disciplines including structural, environmental, geotechnical, water resources, transportation, construction and urban planning.

- Architects primarily focus on designing the interior and exterior “look and feel” of commercial and residential structures meant for human habitation.
- An effective method for brainstorming possible solutions involves a collaboration of many stakeholders with a variety of skills coming together in an organized meeting called a charrette.

*Aligned Washington State Standards*

<b>Communications</b>	<p><b>Comprehension and Collaboration 11-12</b></p> <ol style="list-style-type: none"> <li>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"> <li>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.</li> <li>b. Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.</li> <li>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.</li> <li>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.</li> </ol> </li> <li>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.</li> <li>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.</li> </ol> <p><b>Presentation of Knowledge and Ideas 11-12</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>6. Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (Grades 11–12 Language standards 1 and 3 on page 54 for specific expectations.)</li> </ol>
<b>Educational Technology</b>	<ol style="list-style-type: none"> <li>1.1.1 Generate ideas and create original works for personal and group expression using a variety of digital tools.</li> <li>1.2.1 Communicate and collaborate to learn with others.</li> <li>1.3.1 Identify and define authentic problems and significant questions for investigation and plan strategies to guide inquiry.</li> <li>1.3.2 Locate and organize information from a variety of sources and media.</li> <li>1.3.3 Analyze, synthesize and ethically use information to develop a solution, make informed decisions and report results.</li> <li>1.3.4 Use multiple processes and diverse perspectives to explore alternative solutions.</li> <li>2.1.2 Practice ethical and respectful behavior.</li> <li>2.2.1 Develop skills to use technology effectively.</li> <li>2.2.2 Use a variety of hardware to support learning.</li> <li>2.3.1 Select and use common applications.</li> <li>2.3.2 Select and use online applications.</li> <li>2.4.1 Formulate and synthesize new knowledge.</li> </ol>
<b>Math</b>	<p><b>Quantities N-Q</b></p> <ul style="list-style-type: none"> <li>• Reason quantitatively and use units to solve problems</li> </ul>

	<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><b>Reasoning with Equations and Inequalities A-REI</b></p> <ul style="list-style-type: none"> <li>• Understand solving equations as a process of reasoning and explain the reasoning</li> </ul> <p>1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.</p>
<b>Reading</b>	<p><b>Reading For Literacy in Science and Technical Subjects 11-12</b></p> <p>Key Ideas and Details</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>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>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>
<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>
<b>Writing</b>	<p><b>Literacy in History/Social Studies, Science, and Technical Subjects 11/-12</b></p> <p>Text Types and Purposes</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>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</p>

writing.

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

**Production and Distribution of Writing 11-12**

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.

**COMPONENTS AND ASSESSMENTS**

**Performance Assessments:**

- Identify typical components of a residential framing system.
- Recognize conventional residential roof designs.
- Model a common residential roof design and detail advantages and disadvantages of that style.
- Use 3D architectural software to design, model and document a small building.
- Apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.
- Create a cost estimate for a small construction project, including a detailed cost break-down.
- Calculate the heat loss for a building envelope with given conditions appropriate for the project.
- Apply elements of good residential design to the design of a basic house to meet the needs of a client.
- Design a home design that complies with applicable codes and requirements.
- Incorporate sustainable building principles, energy conservation features, and universal design concepts into a residential design.
- Create bubble diagrams and sketch a floor plan.
- Identify residential foundation types and choose an appropriate foundation for a residential application.
- Calculate the head loss and estimate the water pressure for a given water supply system.
- Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that comply with applicable codes.
- Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.
- Create a site opportunities map and sketch a project site.
- Choose an appropriate building location on a site based on orientation and other site-specific information.
- Calculate the storm water runoff from a site before and after development.
- Document the design of a home using 3D architectural design software and construction drawings.
- Research green and sustainable practices that can be applied to the design of their Affordable House design project. Research includes investigation of techniques to harvest rainwater, environmentally friendly construction methods, recycling of construction wastes, reducing energy consumption, incorporating a site's natural resources into the design of the structure.
- Create a proposal to gain LEED points toward LEED certification for their Affordable Home design project and explain how meeting the prerequisites and criteria for the LEED credit promotes the transformation of the homebuilding industry toward more sustainable practices.
- Research an architecturally designed solution to a community problem and design, fund, build, and install the solution

**Leadership Alignment:**

Classroom Focus:

- Building Design and Construction: Use 3D architectural software to design, model, and document a small building project.
- Cost Efficiency Analysis: Create a cost estimate for the small construction above, including a detailed cost breakdown.

Community Focus:

- Meet with community client and partners to gather project needs and collaborate on design solutions
- Present the project proposal to funders and detail cost estimates and time line

Example: Fence Project -- Work with community policing to identify at risk properties and meet with SPD representative to connect with potential clients to offer a designed security solution for specific properties. Present the plan to the home owner, funders, partners to detail the project start to end and fully fund the project as well as include partners needed to mitigate risk and provide materials and potential installation solutions.

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Manage Projects: Set and meet goals, even in the face of obstacles and competing pressures.

Manage Projects: Prioritize, plan and manage work to achieve the intended result.

***Standards and Competencies***

**Standard/Unit: Residential Design and Project Construction**

**Competencies**

**Total Learning Hours for Unit: 65**

**Building Design and Construction**

- Many residential structures are constructed with wood framing systems and are built using standard practices.
- A variety of roof shapes and materials are available for residential structures to address aesthetic preferences, carry design loads, and meet environmental challenges.
- Designers design, modify, and plan structures using 3D architectural software.
- Architects and engineers use a variety of views to document and detail a building project on construction drawings.

- Knowledge and Skills

**Cost and Efficiency Analysis**

- The combination of concrete and rebar, called reinforced concrete, is an important component of residential foundations.
- Accurately determining the cost and quantities for a construction project can ensure a successful building project providing a high quality structure with less material and financial waste.
- An effective residential structure should include methods for adequate heating and cooling.
- R-value and U-factor measurements are used to select materials that with ensure a structure is properly insulated.

**Residential Design**

- Responsible designers maximize the potential of the property, minimize impact on the environment, and incorporate universal design concepts in order to create an attractive and functional space.
- Responsible designers anticipate the needs and requirements of the users.
- Codes are created to protect the health and safety of the public, dictate the minimum requirements that must be met in a building project, and constrain the location of structures, utilities, building construction, and landscape components placed on a site.
- Appropriate flow rate, pressure, and water quality are necessary for effective water supply and use.
- When utilities are not available within a reasonable distance to be economically brought on site, substitutions must be designed and constructed.
- Utilities and systems must be properly sized to minimize cost and appropriately serve the project and the structure occupants.
- The design of electrical and plumbing systems must be carefully integrated into the architectural and structural design of a building.
- Careful landscape design that takes into consideration local environmental conditions can improve energy efficiency, reduce noise, reduce water usage, reduce storm water runoff, and improve the visual impact of a building project.
- Storm water runoff from a site often increases when the site is developed and is frequently regulated by local jurisdictions.
- Universal Design involves the design of products and environments to be usable by all people and includes barrier free accessibility to projects that may be required by federal regulations.
- Green or sustainable design reduces the negative impact of a project on the environment and human health and improves the performance of the project during its life-cycle. (note Green Activities in Performance Assessments above)

*Aligned Washington State Standards*

**Communications**

**Speaking and Listening Standards**

**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.

	<p><b>Presentation of Knowledge and Ideas 11-12</b></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. Grades 11–12 Language standards 1 and 3 on page 54 for specific expectations.)</p>
<p><b>Educational Technology</b></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>1.3.1 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><b>Math</b></p>	<p>Number and Quantity</p> <p><b>The Real Number System N-RN</b></p> <ul style="list-style-type: none"> <li>• Extend the properties of exponents to rational exponents</li> </ul> <p>2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.</p> <p><b>Quantities N-Q</b></p> <ul style="list-style-type: none"> <li>• Reason quantitatively and use units to solve problems</li> </ul> <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><b>Seeing Structure in Expressions A-SSE</b></p> <ul style="list-style-type: none"> <li>• Interpret the structure of expressions</li> </ul> <p>1. Interpret expressions that represent a quantity in terms of its context.</p> <p>a. Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>2. Use the structure of an expression to identify ways to rewrite it. <i>For example, see <math>x^4 - y^4</math> as <math>(x^2)^2 - (y^2)^2</math>, thus recognizing it as a difference of squares that can be factored as <math>(x^2 - y^2)(x^2 + y^2)</math>.</i></p> <ul style="list-style-type: none"> <li>• Write expressions in equivalent forms to solve problems</li> </ul> <p>3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p><b>Creating Equations A-CED</b></p> <ul style="list-style-type: none"> <li>• Create equations that describe numbers or relationships</li> </ul> <p>1. Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i></p> <p>2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels</p>

and scales.

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

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

#### **Reasoning with Equations and Inequalities A-REI**

- Understand solving equations as a process of reasoning and explain the reasoning

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

#### **Interpreting Functions F-IF**

- Interpret functions that arise in applications in terms of the context

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

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

#### **Building Functions F-BF**

- Build a function that models a relationship between two quantities

1. Write a function that describes a relationship between two quantities.

b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*

c. (+) Compose functions. *For example, if  $T(y)$  is the temperature in the atmosphere as a function of height, and  $h(t)$  is the height of a weather balloon as a function of time, then  $T(h(t))$  is the temperature at the location of the weather balloon as a function of time.*

#### **Trigonometric Functions F-TF**

- Extend the domain of trigonometric functions using the unit circle

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

3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for  $\frac{\pi}{6}$ ,  $\frac{\pi}{4}$ , and  $\frac{\pi}{3}$  and express the values of sine, cosine, and tangent for  $\frac{\pi}{2}$ ,  $\pi$ , and  $2\pi$  in terms of their values for  $x$ , where  $x$  is any real number. 4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

- Model periodic phenomena with trigonometric functions

5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

- Prove and apply trigonometric identities

8. Prove the Pythagorean identity  $\sin^2(\theta) + \cos^2(\theta) = 1$  and use it to find  $\sin(\theta)$ ,  $\cos(\theta)$ , or  $\tan(\theta)$  given  $\sin(\theta)$ ,  $\cos(\theta)$ , or  $\tan(\theta)$  and the quadrant of the angle.

9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Modeling

Modeling Process may include: Problem->Formulate->Compute->Interpret->Validate->Formulate->Repeat cycle ->Report

Geometry

#### **Congruence G-CO**

- 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>distance along a line, and distance around a circular arc.</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> <ul style="list-style-type: none"> <li>• Prove geometric theorems</li> </ul> <p>9. Prove theorems about lines and angles. <i>Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.</i></p> <p><b>Similarity, Right Triangles, and Trigonometry S-SRT</b></p> <ul style="list-style-type: none"> <li>• Understand similarity in terms of similarity transformations</li> </ul> <p>4. Prove theorems about triangles. <i>Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.</i></p> <p>5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.</p> <ul style="list-style-type: none"> <li>• Define trigonometric ratios and solve problems involving right triangles</li> </ul> <p>7. Explain and use the relationship between the sine and cosine of complementary angles.</p> <p>8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.</p> <ul style="list-style-type: none"> <li>• Apply trigonometry to general triangles</li> </ul> <p>9. (+) Derive the formula <math>A = \frac{1}{2} ab \sin(C)</math> for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.</p> <p>10. (+) Prove the Laws of Sines and Cosines and use them to solve problems.</p> <p>11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).</p> <p>Statistics &amp; Probability</p>
<p><b>Reading</b></p>	<p><b>Reading For Literacy in Science and Technical Subjects 11-12</b></p> <p>Key Ideas and Details</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>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>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><b>Science</b></p>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p>

	<p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p> <p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>
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<b>Writing</b>	<p><b>Literacy in History/Social Studies, Science, and Technical Subjects 11-12</b> Text Types and Purposes</p> <ol style="list-style-type: none"> <li>1. Write arguments focused on <i>discipline-specific content</i>.       <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>e. Provide a concluding statement or section that follows from or supports the argument presented.</li> </ol> </li> </ol> <p><b>Production and Distribution of Writing 11-12</b></p> <ol style="list-style-type: none"> <li>4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</li> <li>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.</li> <li>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.</li> </ol> <p>Research to Build and Present Knowledge</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>9. Draw evidence from informational texts to support analysis, reflection, and research.</li> </ol>
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**COMPONENTS AND ASSESSMENTS**

**Performance Assessments:**

**Commercial Building Systems**

- Commercial building systems differ from residential building systems in many significant ways.
- Codes and building regulations define and constrain all aspects of building design and construction including the structure, site design, utilities, and building usage.
- Zoning regulations are used to control land use and development.
- Wall, roof, floor, and framing systems for commercial facilities are chosen based on many factors.

**Structures**

- Given a structural form, describe how the structural form resists and transfers applied loads.
- Use building codes and other resources to calculate roof loading to a structure and select appropriate roof beams to safely carry the load.

- Analyze a simply supported beam subjected to a given loading condition to determine reaction forces, sketch shear and moment diagrams, and determine the maximum moment resulting in the beam.
- Use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
- Use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
- Calculate the deflection of a simply supported beam subjected to a given loading condition.
- Use building codes and other resources to determine the required floor loading and design a structural steel floor framing system (beams and girders) for a given building occupancy.
- Identify and describe the typical usage of foundation systems commonly used in commercial construction.
- Determine the loads transferred from a steel framed structure to the ground through a foundation.
- Size a spread footing for a given loading condition.
- Check structural calculations created by others for correctness.

### **Services and Utilities**

- Identify typical utility services for a commercial building, typical transmission/distribution methods for each utility, and methods for measuring usage.
- Interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
- Read and understand HVAC construction drawings for a commercial project.
- Apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
- Modify system designs to incorporate energy conservation techniques.

### **Site Considerations**

- Use differential leveling to complete a control survey to establish a point of known elevation for a project.
- Design appropriate pedestrian access, vehicular access and a parking lot for a commercial facility.
- Analyze a site soil sample to determine the United Soil Classification System designation and predict soil characteristics important to the design and construction of a building on the site.
- Explain the impact of site development on storm water runoff.
- Estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.
- Identify and explain the purpose of Low Impact Development techniques in site development.
- Apply Low Impact Development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.
- Follow specifications and codes during a design process.
- Given 3D architectural design software, document a commercial site design.

### **Leadership Alignment:**

#### Classroom Project:

- Structures – Determine loads transferred from structure to foundation/footing
- Structures – Size footing for given load conditions
- Site Considerations – Design appropriate pedestrian access, parking considerations
- Site Considerations – Analyze site soil sample to determine the United Soil Classification System designation and predict soil characteristics important to the design and construction of the proposed project solution
- Estimate storm water runoff and mitigate for flow and storage, if needed
- Identify and implement Low Impact Development techniques to reduce the impact on the project environment
- Follow specifications and codes during the design process

#### Community Event:

- Present project solution and mitigation solutions to stakeholders.
- Develop and deliver presentations to seek and gain all formal approvals required for the project.

Think Creatively: Use a wide range of idea creation techniques (such as brainstorming)

Think Creatively: Create new and worthwhile ideas (both incremental and radical concepts)

Think Creatively: Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others: Develop, implement and communicate new ideas to others effectively.

Work Creatively with Others: Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.

Work Creatively with Others: Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas.

Work Creatively with Others: View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

Implement Innovations: Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur.

Reason Effectively: Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking: Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Collaborate with Others: Demonstrate ability to work effectively and respectfully with diverse teams.

Collaborate with Others: Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal.

Collaborate with Others: Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

Apply Technology Effectively: Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

Manage Goals and Time: Utilize time and manage workload efficiently.

Work Independently: Monitor, define, prioritize and complete tasks without direct oversight.

Be Self-directed Learners: Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise.

Manage Projects: Set and meet goals, even in the face of obstacles and competing pressures.

Manage Projects: Prioritize, plan and manage work to achieve the intended result.

Leadership and Responsibility: Guide and lead others.

Leadership and Responsibility: Be responsible to others.

### ***Standards and Competencies***

#### **Standard/Unit: Commercial Applications**

#### **Competencies**

**Total Learning Hours for Unit: 57**

#### **Commercial Building Systems**

- Commercial building systems differ from residential building systems in many significant ways.
- Codes and building regulations define and constrain all aspects of building design and construction including the structure, site design, utilities, and building usage.
- Zoning regulations are used to control land use and development.
- Wall, roof, floor, and framing systems for commercial facilities are chosen based on many factors.

#### **Structures**

- The purpose of a structure is to withstand all applied loads and forces and to transfer these forces to the Earth.
- Structural engineering involves the critical analysis of forces and loads, the anticipated effect of these loads on a structure, and the design of structural elements to safely and efficiently resist the anticipated forces and loads.
- Design loads are often dictated by building codes.
- Structural design includes the determination of how structures disperse the applied loads.
- The application of loads to a building results in resisting forces from the structure which can be predicted through the use of mathematics and physical

science principles.

### Services and Utilities

- When utilities are not available within a reasonable distance to be economically brought on site, substitutions must be designed and constructed.
- Utilities and systems must be properly sized to minimize cost and appropriately serve the project.
- Responsible designers anticipate the needs and requirements of the users.
- The design of mechanical systems impact the architectural and structural design of a building.
- Energy codes are designed to conserve natural resources, reduce operating costs, protect the environment and create healthier living and working spaces. They dictate the minimum requirements for the building envelope, lighting, mechanical systems, and service water heating for commercial facilities.
- The design of internal systems is documented with construction drawings specific to each system.

### Aligned Washington State Standards

<b>Communications</b>	<p><b>Speaking and Listening Standards</b> <b>Comprehension and Collaboration 11-12</b></p> <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><b>Presentation of Knowledge and Ideas 11-12</b></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. (Grades 11–12 Language standards 1 and 3 on page 54 for specific expectations.)</p>
<b>Educational Technology</b>	<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>1.3.1 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>
<b>Math</b>	<p><b>Quantities N-Q</b></p> <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>
<b>Reading</b>	<p><b>Reading For Literacy in Science and Technical Subjects 11-12</b></p> <p>Key Ideas and Details</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>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>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>
<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-</p>

	ETS1-3. offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
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<b>Writing</b>	<p><b>Literacy in History/Social Studies, Science, and Technical Subjects 11-12</b> Text Types and Purposes</p> <ol style="list-style-type: none"> <li>1. Write arguments focused on <i>discipline-specific content</i>.       <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>e. Provide a concluding statement or section that follows from or supports the argument presented.</li> </ol> </li> </ol> <p><b>Production and Distribution of Writing 11-12</b></p> <ol style="list-style-type: none"> <li>4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</li> <li>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.</li> <li>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.</li> </ol> <p>Research to Build and Present Knowledge</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>9. Draw evidence from informational texts to support analysis, reflection, and research.</li> </ol>
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**COMPONENTS AND ASSESSMENTS**

<p><b>Performance Assessments:</b></p> <ul style="list-style-type: none"> <li>• Work individually and in groups to produce a solution to a team project.</li> <li>• Research codes, zoning ordinances and regulations to determine the applicable requirements for a project.</li> <li>• Identify the boundaries of a property based on its legal description.</li> <li>• Perform research and visit a site to gather information pertinent to the viability of a project on the site.</li> <li>• Identify the criteria and constraints, and gather information to promote viable decisions regarding the development of their solution.</li> <li>• Create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.</li> <li>• Communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.</li> <li>• Identify the criteria for commercial property/project viability.</li> <li>• Investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.</li> <li>• Apply current common practices utilized in Civil Engineering and Architecture to develop a viable solution in their project.</li> <li>• Develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.</li> <li>• Assemble and organize work from a commercial project to showcase the project in an effective and professional manner.</li> <li>• Create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for</li> </ul>
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- project development.
- Conduct an oral presentation to present a proposal for the design and development of a commercial building project.

**Leadership Alignment:**

Classroom Focus:

**Project Design Problem**

- Detailed planning, documentation and management of a project is essential to its success.
- Work in teams to produce solutions to complex problems.

**Design Presentation**

- Critiques and reviews are used to inform and provide suggestions for improvement.
- Presentations and displays of work provide the means to effectively promote the implementation of a project.

Community Focus:

- Plan and deliver final presentations to stakeholders
- Implement the plan or prepare the plan for implementation as a capstone project depending on in the initial time line

Think Creatively: Use a wide range of idea creation techniques (such as brainstorming)

Think Creatively: Create new and worthwhile ideas (both incremental and radical concepts)

Think Creatively: Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts

Work Creatively with Others: Develop, implement and communicate new ideas to others effectively.

Work Creatively with Others: Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.

Work Creatively with Others: Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas.

Work Creatively with Others: View failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes and frequent mistakes.

Implement Innovations: Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur.

Reason Effectively: Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation.

Use Systems Thinking: Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems

Collaborate with Others: Demonstrate ability to work effectively and respectfully with diverse teams.

Collaborate with Others: Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal.

Collaborate with Others: Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

Apply Technology Effectively: Use digital technologies (computers, PDAs, media players, GPS, etc.), communication/networking tools and social networks appropriately to access, manage, integrate, evaluate and create information to successfully function in a knowledge economy.

Manage Goals and Time: Utilize time and manage workload efficiently.

Work Independently: Monitor, define, prioritize and complete tasks without direct oversight.

Be Self-directed Learners: Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise.

Manage Projects: Set and meet goals, even in the face of obstacles and competing pressures.

Manage Projects: Prioritize, plan and manage work to achieve the intended result.

***Standards and Competencies***

**Standard/Unit: Commercial Building Design**

**Competencies**

**Total Learning Hours for Unit: 35**

**Commercial Building Design Problem**

- Detailed planning, documentation and management of a project is essential to its success.
- People work in teams to produce solutions to complex problems.
- A legal description of property is used to identify real estate in a legal transaction and can be found in a deed, mortgage, plat or other purchase documents.
- The selection of a site and the project being planned are interrelated. A site should be thoroughly research to determine whether it is compatible with the project to be built.
- Legal, physical, and financial conditions as well as the needs of the surrounding community should be taken into consideration when determining the viability of a project.

**Commercial Building Design Presentation**

- Critiques and reviews are used to inform and provide suggestions for improvement.
- Presentations and displays of work provide the means to effectively promote the implementation of a project.
- A well-done presentation will enhance the quality of a team’s project.

**Aligned Washington State Standards**

<b>Communications</b>	<p><b>Speaking and Listening Standards</b>  <b>Comprehension and Collaboration 11-12</b></p> <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><b>Presentation of Knowledge and Ideas 11-12</b></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. (Grades 11–12 Language standards 1 and 3 on page 54 for specific expectations.)</p>
<b>Educational Technology</b>	<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>1.3.1 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>
<b>Math</b>	<p><b>Quantities N-Q</b></p> <ul style="list-style-type: none"> <li>• Reason quantitatively and use units to solve problems</li> </ul> <ol style="list-style-type: none"> <li>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.</li> <li>2. Define appropriate quantities for the purpose of descriptive modeling.</li> <li>3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</li> </ol>
<b>Reading</b>	<p><b>Reading For Literacy in Science and Technical Subjects 11-12</b></p> <p>Key Ideas and Details</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> </ol> <p>Craft and Structure</p> <ol style="list-style-type: none"> <li>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>.</li> <li>5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</li> </ol> <p>Integration of Knowledge and ideas</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> </ol>
<b>Science</b>	<p>HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.</p> <p>HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</p> <p>HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</p>

	<p>HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</p>
<p><b>Writing</b></p>	<p><b>Literacy in History/Social Studies, Science, and Technical Subjects 11/-12</b>  Text Types and Purposes  1. Write arguments focused on <i>discipline-specific content</i>.  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.  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.</p> <p><b>Production and Distribution of Writing 11-12</b>  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  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.</p>

**21<sup>st</sup> Century Skills**

Check those that students will demonstrate in this course:

**LEARNING & INNOVATION**

**Creativity and Innovation**

- Think Creatively
- Work Creatively with Others
- Implement Innovations

**Critical Thinking and Problem Solving**

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

**Communication and Collaboration**

- Communicate Clearly
- Collaborate with Others

**INFORMATION, MEDIA & TECHNOLOGY SKILLS**

**Information Literacy**

- Access and /evaluate Information
- Use and Manage Information

**Media Literacy**

- Analyze Media
- Create Media Products

**Information, Communications and Technology (ICT Literacy)**

- Apply Technology Effectively

**LIFE & CAREER SKILLS**

**Flexibility and Adaptability**

- Adapt to Change
- Be Flexible

**Initiative and Self-Direction**

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

**Social and Cross-Cultural**

- Interact Effectively with Others
- Work Effectively in Diverse Teams

**Productivity and Accountability**

- Manage Projects
- Produce Results

**Leadership and Responsibility**

- Guide and Lead Others
- Be Responsible to Others