Tumwater School District

Course: Introduction to Aeronautical Engineering		**Total Framework Hours up to: 180**
CIP Code: 149998	☒**Exploratory** ☐**Preparatory**	**Date Last Modified: 1/21/15**
Career Cluster: Science, Technology, Engineering, Math		**Cluster Pathway: Aeronautical Engineering**

COMPONENTS AND ASSESSMENTS

Unit 1 Performance Assessments: **STEM-Based Inquiry: The Generation of Lift**

A. Study of air pressure
   1. Students will compare toys that fly (paper airplanes, kites, Frisbees, propeller sticks, boomerangs, and parachutes).
   2. Students will review Newton's three laws of motion.

B. Factors affecting lift generated by an airfoil
   1. Students will determine how an airfoil generates lift.
   2. Students will graph effects of changing four factors that influence lift generated by an airfoil.

C. Airfoil design and testing
   1. Students will design and cut out airfoils from foam.
   2. Students will test airfoils in analytical wind tunnel.

D. Students will construct wing section for Sonex aircraft.

Leadership Alignment 21st Century Skills Standards:

Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.
Standard 2.1: The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.

2.A.1: Use various types of reasoning as appropriate to the situation.
2.B.1: Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems.
2.C.1: Effectively analyze and evaluate evidence, arguments, claims, and beliefs.
2.C.4: Effectively interpret information and draw conclusions bases on the best analysis.
2.C.5: Reflect critically on learning experiences and processes.
2.D.1: Effectively solve different kinds of non-familiar problems in both conventional and innovative ways.

Student teams will design and test foam airfoils in a wind tunnel; analyze airfoil polars and design wings for two different aircraft; carve and test propeller designs, and design and test fly their aircraft in a flight simulator.

Standards and Competencies

C-1 Standard:

ITEA Standards for Technological Literacy (STL) 8: Students will develop an understanding of the attributes of design.
ITEA Standards for Technological Literacy (STL) 9: Students will develop an understanding of engineering design.
ITEA Standards for Technological Literacy (STL) 11: Students will develop the abilities to apply the design process.

Competencies	Total Learning Hours for Unit: 20
• C-1.1: STL Standard 8, Benchmark F: There is no perfect design. • C-1.2: STL Standard 8, Benchmark G: Requirements for design are made up of criteria and constraints. • C-1.3: STL Standard 9, Benchmark H: Modeling, testing, and modifying are used to transform ideas into practical solutions. • C-1.4: STL Standard 9, Benchmark K: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments. • C-1.5: STL Standard 11, Benchmark J: Make two-dimensional and three-dimensional representations of the designed solution. • C-1.6: STL Standard 11, Benchmark K: Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.	
Aligned Washington State Standards	
Communications (Common Core)	W 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. W 6: Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. W 7: Conduct short as well as more sustained research projects to answer a question or solve a problem.
Math (Common Core)	A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A-REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. F-BF.1: Write a function that describes a relationship between two quantities. F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. N-VM.1: Recognize vector quantities as having both magnitude and direction. N-VM.4: Add and subtract vectors.
Reading (Common Core)	RST: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
Science (NGSS)	HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
Writing (Common Core)	W 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. W 2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. W 9: Draw evidence from literary or informational texts to support analysis, reflection, and research.
COMPONENTS AND ASSESSMENTS	
Unit 2 Performance Assessments: **STEM-Based Inquiry: Lift Generated by a Wing** A. Forces on a glider 1. Students will construct a balsa wood/Styrofoam glider. 2. Students will construct wings with various geometric shapes (planforms) to compare flight characteristics of glider. 3. Students will determine best center of gravity location and wing placement for longest duration of flight.	

B. Wing Design Challenge
   1. Students will analyze airfoil polars and design wings for two different aircraft.
   2. Students will present their design choices and evaluate other groups' choices.

Leadership Alignment 21st Century Skills Standards:
Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.
Standard 2.1: The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.

2.D.1: Effectively solve different kinds of non-familiar problems in both conventional and innovative ways.
4.B.1: Use information accurately and creatively for the issue or problem at hand.
6.A.1: Use technology as a tool to research, organize, evaluate, and communicate information.
3.B.1 Demonstrate ability to work effectively and respectfully with diverse teams
3.B.3 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member
10.A.1 Set and meet goals, even in the face of obstacles and competing pressures

Student teams will continue their work to design and test and test fly their aircraft in a flight simulator. During this process, they will engage in lab activities to learn about how different geometric shapes affect flight, as well as determining an object's center of gravity. Students will be expected to develop a presentation about their design choices and test results for peer feedback.

Standards and Competencies

C-2 Standard:

ITEA Standards for Technological Literacy (STL) 8: Students will develop an understanding of the attributes of design.
ITEA Standards for Technological Literacy (STL) 9: Students will develop an understanding of engineering design.
ITEA Standards for Technological Literacy (STL) 11: Students will develop the abilities to apply the design process.

Competencies	**Total Learning Hours for Unit: 12**

- C-2.1: STL Standard 8, Benchmark F: There is no perfect design.
- C-2.2: STL Standard 8, Benchmark G: Requirements for design are made up of criteria and constraints.
- C-2.3: STL Standard 9, Benchmark H: Modeling, testing, and modifying are used to transform ideas into practical solutions.
- C-2.4: STL Standard 9, Benchmark K: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.
- C-2.5: STL Standard 11, Benchmark J: Make two-dimensional and three-dimensional representations of the designed solution.
- C-2.6: STL Standard 11, Benchmark K: Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
- C-2.7: STL Standard 11, Benchmark L: Make a product or system and document the solution.

Aligned Washington State Standards

Communications (Common Core)	W 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. W 6: Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. W 7: Conduct short as well as more sustained research projects to answer a question or solve a problem.
Math (Common Core)	A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A-REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. F-BF.1: Write a function that describes a relationship between two quantities.

	F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. N-VM.1: Recognize vector quantities as having both magnitude and direction. N-VM.4: Add and subtract vectors.
Reading (Common Core)	RST: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
Science (NGSS)	HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
Writing (Common Core)	W 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. W 2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. W 9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

COMPONENTS AND ASSESSMENTS

Unit 3 Performance Assessments: **STEM-Based Inquiry: Propeller Engineering Competition**

A. Aircraft Propulsion Systems
   1. Students will research and learn how various aircraft propulsion systems work.
   2. Students will present research findings using a PowerPoint presentation they create as a team.

B. Propeller Engineering Design Challenge
   1. Students will carve their own propeller designs.
   2. Propeller designs will be evaluated using NASA's Propeller Engineering Design Challenge format.
   3. Students will tour a local company that designs and installs turbine engines into aircraft.

Leadership Alignment 21st Century Skills Standards:

Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.
Standard 2.1: The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.

2.C.1 Effectively analyze and evaluate evidence, arguments, claims and beliefs
2.C.2 Analyze and evaluate major alternative points of view
2.C.3 Synthesize and make connections between information and arguments
2.C.4 Interpret information and draw conclusions based on the best analysis
3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
4.A.1 Access information efficiently (time) and effectively (sources)
4.A.2 Evaluate information critically and competently

Students will use online resources, community advisors, and school databases to conduct research and develop a presentation. They will apply their learning to carve and test propeller designs.

Standards and Competencies

C-3 Standard:

ITEA Standards for Technological Literacy (STL) 8: Students will develop an understanding of the attributes of design.
ITEA Standards for Technological Literacy (STL) 9: Students will develop an understanding of engineering design.
ITEA Standards for Technological Literacy (STL) 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
ITEA Standards for Technological Literacy (STL) 11: Students will develop the abilities to apply the design process.
ITEA Standards for Technological Literacy (STL) 18: Students will develop an understanding of and be able to select and use transportation technologies.

Competencies	**Total Learning Hours for Unit: 14**

- C-3.1: STL Standard 8, Benchmark F: There is no perfect design.
- C-3.2: STL Standard 8, Benchmark G: Requirements for design are made up of criteria and constraints.
- C-3.3: STL Standard 9, Benchmark G: Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum.
- C-3.4: STL Standard 9, Benchmark H: Modeling, testing, and modifying are used to transform ideas into practical solutions.
- C-3.5: STL Standard 9, Benchmark K: A prototype is a working model used to test a design concept by making actual observations and necessary adjustments.
- C-3.6: STL Standard 10, Benchmark F: Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.
- C-3.7: STL Standard 10, Benchmark G: Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.
- C-3.8: STL Standard 10, Benchmark H: Some technological problems are best solved through experimentation.
- C-3.9: STL Standard 11, Benchmark J: Make two-dimensional and three-dimensional representations of the designed solution.
- C-3.10: STL Standard 11, Benchmark K: Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed.
- C-3.11: STL Standard 11, Benchmark L: Make a product or system and document the solution.
- C-3.12: STL Standard 18, Benchmark G: Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively.

Aligned Washington State Standards	
Communications (Common Core)	W 4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. W 6: Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically. W 7: Conduct short as well as more sustained research projects to answer a question or solve a problem.
Math (Common Core)	A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A-REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. F-BF.1: Write a function that describes a relationship between two quantities. F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. N-VM.1: Recognize vector quantities as having both magnitude and direction. N-VM.4: Add and subtract vectors.
Reading (Common Core)	RST: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

Science (NGSS)	HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
Social Studies	4.4: Uses history to understand the present and plan for the future.
Writing (Common Core)	W 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. W 2: Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content. W 9: Draw evidence from literary or informational texts to support analysis, reflection, and research.

COMPONENTS AND ASSESSMENTS

Unit 4 Performance Assessments: **Simulation Experience: Controllable Surfaces**

A. Longitudinal, lateral, and yaw axes of aircraft control
   1. Students will build various aircraft from paper and Styrofoam to test effects of controllable surfaces on aircraft's flight path.
   2. Students will apply understanding of airfoils to explain how controllable surfaces create unbalanced forces.

B. Flight simulators
   1. Students will demonstrate ability to control aircraft in flight by using controllable surfaces while flying a flight simulator.
   2. Students will demonstrate ability to control a radio-controlled aircraft with controllable surfaces while flying an R/C simulator.
   3. Students will demonstrate ability to control a radio-controlled aircraft with controllable surfaces by flying actual aircraft in the school gym.

Leadership Alignment 21st Century Skills Standards:

Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.

4.A.1 Access information efficiently (time) and effectively (sources)
4.A.2 Evaluate information critically and competently
7.A.1 Adapt to varied roles, jobs responsibilities, schedules and contexts
8.A.1 Set goals with tangible and intangible success criteria

Student teams will apply their knowledge of shapes and center of gravity to explore the relationship with various materials and forces in a laboratory setting. They will watch videos and work in partnered activities to learn to fly both a simulated and an actual radio controlled aircraft.

Standards and Competencies

C-4 Standard:

ITEA Standards for Technological Literacy (STL) 9: Students will develop an understanding of engineering design.
ITEA Standards for Technological Literacy (STL) 12: Students will develop the abilities to use and maintain technological products and systems.
ITEA Standards for Technological Literacy (STL) 18: Students will develop an understanding of and be able to select and use transportation technologies.

Washington State Science Standard 6-8 PS1C: Unbalance forces will cause changes in the speed or direction of an object's motion. The motion of an object will stay the same when the forces are balanced.

Competencies	**Total Learning Hours for Unit: 23**

- C-4.1: STL Standard 9, Benchmark H: Modeling, testing, and modifying are used to transform ideas into practical solutions.
- C-4.2: STL Standard 12, Benchmark J: Use computers and calculators in various applications.
- C-4.3: STL Standard 18, Benchmark G: Transportation vehicles are made up of subsystems, such as structural propulsion, suspension, guidance, control, and support that must function together for a system to work effectively.

Aligned Washington State Standards	
Communications (Common Core)	WHST: Write arguments focused on discipline-specific content.
Educational Technology	1.1.2: Use models and simulations to explore systems, identify trends and forecast possibilities. 2.2.1: Develop skills to use technology effectively.
Math (Common Core)	N-VM.1: Recognize vector quantities as having both magnitude and direction. N-VM.4: Add and subtract vectors.
Reading (Common Core)	RST: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
Science (NGSS)	HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

COMPONENTS AND ASSESSMENTS

Unit 5 Performance Assessments: Simulation Experience: Cross-country flight planning

A. Distance, rate, time calculations
   1. Students will learn to use E6B flight computers to calculate distance, rate, and time problems.
   2. Students will learn to use E6B flight computers to determine wind effects on ground speed and true course headings.

B. Reading a sectional
   1. Students will learn how to read sectionals (flight maps).
   2. Students will learn how to use plotters to measure distance and true course headings.

C. Cross-country flight competition
   1. Students will use the E6B computer, sectional, and plotter to plan a flight from one airport to another.
   2. Students will fly their flight plan on a computer flight simulator.

Leadership Alignment 21st Century Skills Standards:

Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.
Standard 2.1: The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.

6.A.1 Use technology as a tool to research, organize, evaluate and communicate information
6.A.2 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

During this unit, students will practice using flight computers. They will work in both individual and partnered activities to review settings, make calculations, and solve

problems related to flight. Students will also engage in classroom work to build their map-reading and map-use skills. As a culminating activity, students will be expected to apply their new learning to develop a flight plan and then test it in the simulator.

Standards and Competencies

C-5 Standard:

Math Standard 7.1: Rational numbers and linear equations.
Math Standard 7.6: Reasoning, problem solving and communication.
ITEA Standards for Technological Literacy (STL) 12: Students will develop the abilities to use and maintain technological products and systems.

Competencies	**Total Learning Hours for Unit: 17**

- C-5.1: Common Core Mathematics A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
- C-5.2: Common Core Mathematics A-REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- C-5.3: Common Core Mathematics F-BF.1: Write a function that describes a relationship between two quantities.
- C-5.4: Common Core Mathematics N-VM.3: Solve problems involving velocity and other quantities that can be represented by vectors.
- C-5.5: STL Standard 12, Benchmark H: Use information provided in manuals, protocols, or by experienced people to see and understand how things work.
- C-5.6: STL Standard 12, Benchmark J: Use computers and calculators in various applications.

Aligned Washington State Standards

Communications (Common Core)	SL: Initiate and participate effectively in a range of collaborative discussions with diverse partners.
Educational Technology	1.1.2: Use models and simulations to explore systems, identify trends and forecast possibilities. 2.2.1: Develop skills to use technology effectively.
Math (Common Core)	See Standards and Competencies above.
Reading (Common Core)	RST: Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
Science (NGSS)	HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

COMPONENTS AND ASSESSMENTS

Unit 6 Performance Assessments: **Engineering Experience: Designing an Aircraft**

A. Students will analyze current aircraft designs
   1. Students will understand the design criteria for aircraft to qualify for Light Sport Aircraft designation.
   2. Students will analyze existing Light Sport Aircraft to become aware of design compromises present in those aircraft.

B. Aircraft Design Software
   1. Students will design their own Light Sport Aircraft using aircraft design software.
   2. Students will evaluate the flying characteristics of their aircraft design by importing their design into a flight simulator.

Leadership Alignment 21st Century Skills Standards:
Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.

2.C.4 Interpret information and draw conclusions based on the best analysis
2.D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways
4.B.1 Use information accurately and creatively for the issue or problem at hand
8.C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one's own learning and opportunities to gain expertise
8.C.2 Demonstrate initiative to advance skill levels towards a professional level

During this unit, students will review industry standards for light sport aircraft. They will be expected to synthesize previous information from the course regarding aircraft design and materials to create their own version of an airplane. Students will then test their design in a simulator to determine its effectiveness.

Standards and Competencies

C-6 Standard:

ITEA Standards for Technological Literacy (STL) 8: Students will develop an understanding of the attributes of design.
ITEA Standards for Technological Literacy (STL) 9: Students will develop an understanding of engineering design.
ITEA Standards for Technological Literacy (STL) 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
ITEA Standards for Technological Literacy (STL) 11: Students will develop abilities to apply the design process.
ITEA Standards for Technological Literacy (STL) 12: Students will develop abilities to use and maintain technological products and systems.

Competencies	**Total Learning Hours for Unit: 45**

- C-6.1: STL Standard 8, Benchmark F: There is no perfect design.
- C-6.2: STL Standard 8, Benchmark G: Requirements for design are made up of criteria and constraints.
- C-6.3: STL Standard 9, Benchmark F: Design involves a set of steps, which can be performed in different sequences and repeated as necessary.
- C-6.4: STL Standard 9, Benchmark H: Modeling, testing, and modifying are used to transform ideas into practical solutions.
- C-6.5: STL Standard 10, Benchmark G: Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it.
- C-6.6: STL Standard 11, Benchmark H: Apply a design process to solve problems in and beyond the laboratory-classroom.
- C-6.7: STL Standard 11, Benchmark I: Specify criteria and constraints for the design.
- C-6.8: STL Standard 11, Benchmark L: Make a product or system and document the solution.
- C-6-9: STL Standard 12, Benchmark J: Use computers and calculators in various applications.

Aligned Washington State Standards

Communications (Common Core)	SL: Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
Educational Technology	1.1.2: Use models and simulations to explore systems, identify trends and forecast possibilities. 2.2.1: Develop skills to use technology effectively.
Math (Common Core)	F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
Reading (Common Core)	RI: Cite strong and thorough textual evidence to support of analysis of what the text says explicitly as well as inferences drawn from the text.
Science (NGSS)	HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of

	constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
Social Studies	2.1: Understands that people have to make choices between wants and needs and evaluate the outcomes of those choices.
Writing (Common Core)	W 1: Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

COMPONENTS AND ASSESSMENTS

Unit 7 Performance Assessments: Aircraft Construction

A. Students will construct a rib D-section out of aluminum.
B. Students will construct a jet powered by water for elementary students to ride in.
C. Students will construct an actual aircraft designed in the 1930's and one designed in the 21st century.

Leadership Alignment 21st Century Skills Standards:

Standard 1.4: The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.
Standard 1.5: The student will demonstrate self-advocacy skills by achieving planned, individual goals.
Standard 2.1: The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.

11.A.1 Use interpersonal and problem-solving skills to influence and guide others toward a goal
11.A.2 Leverage strengths of others to accomplish a common goal

In the final unit, students will work together as a class to develop projects to share with the public, such as a ride for children. They will develop scale models of airplane parts, including the smaller version of an airplane. Through the construction process of two actual size planes, students will compare and contrast the design of each model and list the effects of the design changes on flight.

Standards and Competencies

C-7 Standard:

ITEA Standards for Technological Literacy (STL) 11: Students will develop abilities to apply the design process.

Competencies	**Total Learning Hours for Unit: 49**

- C-7.1: STL Standard 11, Benchmark J: Make two-dimensional and three-dimensional representations of the designed solution.

Aligned Washington State Standards

Communications (Common Core)	SL: Initiate and participate effectively in a range of collaborative discussions with diverse partners.
Math (Common Core)	A-SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A-REI.2: Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. F-BF.1: Write a function that describes a relationship between two quantities. F-IF.4: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
Reading (Common Core)	RI: Cite strong and thorough textual evidence to support of analysis of what the text says explicitly as well as inferences drawn from the text.
Science (NGSS)	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.
Social Studies	4.4: Uses history to understand the present and plan for the future.

The 21st Century Skills should be taught and assessed throughout the course.This table should be included at the end of this document.

21st 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** **X** Reason Effectively ☐**U**se Systems Thinking **X** Make Judgments and Decisions **X** Solve Problems **Communication and Collaboration** **X** Communicate Clearly **X** Collaborate with Others	**INFORMATION, MEDIA & TECHNOLOGY SKILLS** **Information Literacy** **X** Access and /evaluate Information **X** Use and Manage Information **Media Literacy** **X** Analyze Media ☐ Create Media Products **Information, Communications and Technology (ICT Literacy)** **X** Apply Technology Effectively	**LIFE & CAREER SKILLS** **Flexibility and Adaptability** ☐Adapt to Change **X** Be Flexible **Initiative and Self-Direction** **X** Manage Goals and Time **X** Work Independently **X** Be Self-Directed Learners **Social and Cross-Cultural** **X** Interact Effectively with Others **X** Work Effectively in Diverse Teams **Productivity and Accountability** **X** Manage Projects **X** Produce Results **Leadership and Responsibility** ☐Guide and Lead Others **X** Be Responsible to Others