EVERETT PUBLIC SCHOOLS
COORDINATED SCIENCE

Course: Technologies Foundations		**Total Framework Hours:** 180
CIP Code: 210198	☒Exploratory ☐Preparatory	**Date Last Modified:** 01.2014
Career Cluster: Science, Technology, Engineering and Mathematics		**Cluster Pathway:** Science, Technology, Engineering and Mathematics

Industry-Recognized Certificates:

Work-Based Learning:

Course Information:
Standards and competencies used in this framework are from the International Technology Education Association (ITEA) Standards for Technical Literacy outlined in the OSPI Model Framework for Technologies Foundations

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students work in groups to design solutions to complex world problems (non-fossil fuel transportation, green energies sources, etc.) by applying their understanding of science to the engineering design process. Solutions are evaluated and prioritized based on criteria, constraints, and trade-offs. Understanding of the nature and scope of technology are assessed through direct lessons, questions, and formal assessment of the process and solutions employed by the students. An intentional emphasis is placed on the importance of collaborative work in the technological design process. Assessment of this element is completed through group reflection rubrics.	
Leadership Alignment: Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only).	
Standards and Competencies	
Unit: The characteristics and scope of technology	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 15
• Standard 1: The characteristics and scope of technology. • C1.1 The history and development of technological knowledge and processes are functions of the setting and have been driven by needs. • C1.2 The rate of technological development and diffusion is increasing rapidly; advancements in technology drive more advances in technology. • C1.3 Inventions and innovations in a specific area are generally driven by research to achieve a specific objective. • C1.6 Non-traditional training and employment options/opportunities are both possible and encouraged in all technologies.	
Aligned Washington State Learning Standards	
English Language Arts	Physical Sciences HS-PS1 Matter and Its Interactions

	HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy. HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 1. Patterns. 3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. CC: Writing (9-10) Research to Build and Present Knowledge (9-10)

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Through the two main design performance assessments (wind turbine design and catapult boat), students apply their understanding of the core concepts in technology: systems thinking, negative and positive feedback loops, constraints/criteria, quality control, and resource management. Students also experience the relationship between science and technology by applying their understanding of science concepts to the design process.
- In the climate chapter of the course, students study the different forms of technology used to find the characteristics of paleoclimates (past climates). Ice cores, coral analysis, isotope ratios, and pollen sample data are analyzed. The trade-offs and benefits of each form are discussed. Student proficiency is assessed through traditional tests, projects, and discussion.
- In the chemistry unit, students analyze the different forms of technology used to determine the characteristics of an atom. Different historic models of the atoms are studied along with the technologies used to contribute to the model. Students learn that limitations and characteristics of technology contributes to the physical and conceptual outcome of the model.

Leadership Alignment:

Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)

Standards and Competencies

Unit: The core concepts of technology

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 20

- Standard 2: The core concepts of technology.
- C2.1 Systems thinking involves input, process, output and feedback and applies logic and creativity with appropriate compromises in complex real-life problems.
- C2.2 Technological systems interact with other systems including social, environmental, and scientific. Outputs - expected desirable, expected undesirable, unexpected desirable, unexpected undesirable.
- C2.3 Systems feedback is the process we use to measure and adjust a system based on the output. The stability of a technological system is influenced by all of the components in the system.
- C2.4 Tradeoffs result from competing values such as availability, cost, desirability, and waste within a system.
- C2.5 Requirements involve the identification of the criteria and constraints of a product or system. The system design is driven by the requirements.
- C2.6 Constraints impact the design process.
- C2.7 New technology creates new processes.

Aligned Washington State Learning Standards

English Language Arts	CC: Reading for Literacy in Science and Technical Subjects Key Ideas and Details: Craft and Structure: Integration of Knowledge and Ideas: Range of Reading and Level of Text Complexity:
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment

	HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 1. Patterns. 4. Systems and system models. 6. Structure and function. 7. Stability and change.
Social Studies	Economics Econ 2.1: Understands that people have to make choices between wants and needs and evaluate the outcomes of those choices. Econ 2.4: Understands the economic issues and problems that all societies face.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- The relationship between science and technology is the main focus of the course. Students use science to design solutions and interpret data gained from technology. An emphasis is placed on the inseparable nature of science and technology.
- Technology design projects include:
  Green Propulsion Boat (catapult boat)
  Wind Turbine Design Project
  Alternative energy plan (for a country other than the United States)
  Solar data Analysis and Elementary Solar Panel design (Middle school version only)
- Data Analysis experience:
  Motion Detectors
  Precision/Accuracy Analysis
  Paleoclimate

Leadership Alignment:

Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)

Standards and Competencies

Unit: The relationship among technologies and the connections between others

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 20

- Standard 3: The relationships among technologies and the connections between technology and other fields of study.
- C3.1 Technology transfer occurs when a new user applies an existing innovation developed for one purpose in a different function; al technical systems are interrelated.
- C3.2 Technological innovation often results when ideas, knowledge, or skills are shared within a technology, among technologies, or across other fields.
- C3.4 Technological progress promotes the understanding and relevance of science, mathematics, reading, writing and oral communications.

Aligned Washington State Learning Standards	
English Language Arts	CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (9-10) Text Types and Purposes (9-10) WHST.9-10.1 Write arguments focused on discipline-specific content. WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience WHST.9-10.1c Use words, phrases, and clauses 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. WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented. Production and Distribution of Writing (9-10) WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. Research to Build and Present Knowledge (9-10) Range of Writing (9-10) WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environme HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations

	4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • All engineering design activities emphasis the importance of the consideration of criteria and constraints including satisfying any requirements set by society such as ethical considerations, financial impacts, cultural consequences, and risk mitigation. Solutions are judged by not only their technological feasibility, but also to the extent they meet these requirements.	
Leadership Alignment:	
Standards and Competencies	
Unit: The cultural, social, economics, and political effects of technology	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 15
• Standard 4: The cultural, social, economics, and political effects of technology. • C4.1 Changes caused by the use of technology can range from gradual to rapid and from subtle to obvious. • C4.2 Making decisions about the use of technology involves understanding the impacts.	
Aligned Washington State Learning Standards	
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

	HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.
Social Studies	Economics Econ 2.1: Understands that people have to make choices between wants and needs and evaluate the outcomes of those choices.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- The class has two capstone projects that involve solutions that alleviate stress on the environment. Students initially study renewable and nonrenewable energy and the impacts of energy consumption.
- Student understanding is assessed by evidence-based explanations of the use of technology on the environment.

Leadership Alignment:

Students work in a collaborative environment to design a green technology wind turbine and boat. Explanations are given that tie their design to the green technology.

Standards and Competencies

Unit: The effects of technology on the environment

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 10

- Standard 5: The effects of technology on the environment.
- C5.1 Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing, reducing, and recycling; technology impacts on the environment can be either positive or negative depending on how they are used.
- C5.2 When new technologies are developed to reduce the use of resources, considerations of the impacts are important.
- C5.5 Humans devise technologies to reduce the negative consequences of other technologies.
- C5.6 Decisions regarding the implementation of technologies involve the weighing of trade-offs between predicted positive and negative impacts on the environment.

Aligned Washington State Learning Standards

Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others.

	4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design 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 environment Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 1. Patterns. 2. Cause and effect: Mechanism and explanation. 3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students understand that technological innovation is a response to a problem in society. Students are required to explain why their design solves a problem by making sure to give weight to the benefits to society. (Note: not a well-developed standard in this course)	
Leadership Alignment: Students work in a collaborative environment to design a green technology wind turbine and boat. Explanations are given that tie their design to the green technology	
Standards and Competencies	
Unit: The role of society in the development and use of technology	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 3
• Standard 6: The role of society in the development and use of technology. • C6.4 The decision whether to develop a technology is influenced by societal opinions and demands, in addition to corporate cultures.	
Aligned Washington State Learning Standards	
English Language Arts	CC: Reading for Literacy in Science and Technical Subjects Key Ideas and Details (9-10) Craft and Structure (9-10)

	Key Ideas and Details (11-12) Craft and Structure (11-12) Integration of Knowledge and Ideas (11-12) Range of Reading and Level of Text Complexity (11-12)
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change. Earth and Space Sciences HS-ESS2 Earth's Systems HS-ESS3 Earth and Human Activity

COMPONENTS AND ASSESSMENTS
Performance Assessments: • Students analyze the different forms of technology used to determine the characteristics of an atom. Different historic models of the atoms are studied along with the technologies used to contribute to the model. • Students learn that limitations and characteristics of technology contributes to the physical and conceptual outcome of the model.
Leadership Alignment: Students present a history of the technology leading to different models

Standards and Competencies	
Unit: The influence of technology on history	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 7
• Standard 7: The influence of technology on history. • C7.1 Most technological development has been evolutionary, the result of a series of refinements to a basic invention; many technology changes have driven and have been impacted by history. • C7.2 Civilization has been directly affected by, and has in turn affected, the development and use of tools and materials.	
Aligned Washington State Learning Standards	
Science	Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment
Social Studies	History History 4.1: Understands historical chronology. History 4.2: Understands and analyzes causal factors that have shaped major events in history. History 4.3: Understands that there are multiple perspectives and interpretations of historical events.

COMPONENTS AND ASSESSMENTS
Performance Assessments: • Within their design groups, students brainstorm optimum design for solutions. They are required to take into consideration the constraints, trade-offs, and efficiencies of one design over another. Students are required to implement a design model of the solutions. Re-design is emphasized as a necessary element of successful design. • Technology design projects include: Green Propulsion Boat (catapult boat) Wind Turbine Design Project Alternative energy plan (for a country other than the United States) Solar data Analysis and Elementary Solar Panel design (Middle school version only)
Leadership Alignment: Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)
Standards and Competencies

Unit: The attributes of design	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 15
• Standard 8: The attributes of design. • DP8.1 Design problems are seldom presented in a clearly defined form; the best results are often based on the clarity of the design problem. • DP8.2 The design needs to be continually checked and critiqued, and the ideas of the design must be redefined and improved; the best results are often achieved when the process in non-linear. • DP8.3 Requirements of a design, such as criteria, constraints, and efficiency, sometimes compete with each other.	
Aligned Washington State Learning Standards	
English Language Arts	CC: Reading for Literacy in Science and Technical Subjects Key Ideas and Details (9-10) Craft and Structure (9-10) Integration of Knowledge and Ideas (9-10) Range of Reading and Level of Text Complexity (9-10) Key Ideas and Details (11-12) Craft and Structure (11-12) Integration of Knowledge and Ideas (11-12) Range of Reading and Level of Text Complexity (11-12)
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation.

	3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • The design process is taught as "chapter challenges" within the course. The challenges emphasize stages of design: identifying the problem, identifying constraints, brainstorming solutions, selecting a solution, creating a preliminary model, testing/evaluation, communicating the solution, and refining the design. The importance of a secondary design is intertwined throughout. • Students are judged on their ability to work collaboratively in addition to their final solution. 21st Century skills are stressed as a necessary component of successful design.	
Leadership Alignment: Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)	
Standards and Competencies	
Unit: Design process	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 25
• Standard 9: The design process • DP9.1 Established design principles are used to evaluate existing designs, to collect data, and to guide the design process; Design principles are often rules of thumb rather than absolutes. • DP9.2 The design process is influenced by personal characteristics, such as creativity, teamwork, resourcefulness, and the ability to visualize and think abstractly. • DP9.4 The design process considers a number of factors, including safety, reliability, economic considerations, manufacturability, maintenance and repairs, and human factors engineering; the design process can't be complete without a prototype or virtual model.	
Aligned Washington State Learning Standards	
English Language Arts	CC: Reading for Literacy in Science and Technical Subjects Key Ideas and Details (9-10) Craft and Structure (9-10) Integration of Knowledge and Ideas (9-10) Key Ideas and Details (11-12) Craft and Structure (11-12) Integration of Knowledge and Ideas (11-12) Range of Reading and Level of Text Complexity (11-12) CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (9-10) Text Types and Purposes (9-10) WHST.9-10.1 Write arguments focused on discipline-specific content. WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence. WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes

	WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. Production and Distribution of Writing (9-10) WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. WHST.9-10.5 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. Research to Build and Present Knowledge (9-10) Range of Writing (9-10) WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
Science	Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation. 3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change. Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy Earth and Space Sciences HS-ESS3 Earth and Human Activity

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Before students begin an engineering design project, they learn the necessary science through lessons in the book. They apply this "research" to the development of their design.
- During the capstone projects student research through experimentation the effects of variables on performance. They present their findings during a community review of the work. The research is incorporated into the design process.
- Students also consult secondary resources such as community professionals and historic designs.

Leadership Alignment:

Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)

Standards and Competencies

Unit: The role of troubleshooting, research and development, invention, and exploration

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 25

- Standard 10: The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- DP10.1 Research and development is an integral part of the design process.
- DP10.2 Technological problems must be researched before they can be solved.
- DP10.4 Many technological problems require a multidisciplinary approach.

Aligned Washington State Learning Standards

English Language Arts	CC: Writing (9-10) Text Types and Purposes (9-10) W.9-10.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence. W.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence. W.9-10.1b Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns. W.9-10.1c Use words, phrases, and clauses 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. W.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. W.9-10.1e Provide a concluding statement or section that follows from and supports the argument presented. W.9-10.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. 8 - Look for and express regularity in repeated reasoning.
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions

	HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer Earth and Space Sciences HS-ESS3 Earth and Human Activity Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 1. Patterns. 2. Cause and effect: Mechanism and explanation. 3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Within their design groups, students brainstorm optimum design for solutions. They are required to take into consideration the constraints, trade-offs, and efficiencies of one design over another. Students are required to implement a design model of the solutions. Re-design is emphasized as a necessary element of successful design.
- Technology design projects include:
  Green Propulsion Boat (catapult boat)
  Wind Turbine Design Project
  Alternative energy plan (for a country other than the United States)
  Solar data Analysis and Elementary Solar Panel design (Middle school version only)

Leadership Alignment:

Students work in a collaborative environment to design a green technology wind turbine, renewable energy boat, alternative energy plan (for a country other than the United States), solar data Analysis and Elementary Solar Panel design (Middle school version only)

Standards and Competencies	
Unit: Apply the design process	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 25
• Standard 11: Apply the design process. • DP11.1 Identify the design problem to solve and decide whether or not to address it; differentiate between problems and solutions. • DP11.2 Identify criteria and constraints and determine how these will affect the design process. • DP11.3 Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product. • DP11.4 Evaluate the design solution using conceptual, physical, and mathematical models at various intervals of the design process in order to check for proper design and to note where areas of improvements are needed. • DP11.5 Develop and produce a product or system using a design process. • DP11.6 Evaluate final solutions and communicate observations, processes, and results of the entire design process, using verbal, graphic, quantitative, virtual, and written means, in addition to three-dimensional models.	
Aligned Washington State Learning Standards	
English Language Arts	CC: Reading for Literacy in Science and Technical Subjects Key Ideas and Details (9-10) Craft and Structure (9-10) Integration of Knowledge and Ideas (9-10) Range of Reading and Level of Text Complexity (9-10) Key Ideas and Details (11-12) Craft and Structure (11-12) Integration of Knowledge and Ideas (11-12) Range of Reading and Level of Text Complexity (11-12) CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects (9-10) Text Types and Purposes (9-10) Production and Distribution of Writing (9-10)
Mathematics	CC: Mathematical Practices (MP) 1 - Make sense of problems and persevere in solving them. 2 - Reason abstractly and quantitatively. 3 - Construct viable arguments and critique the reasoning of others. 4 - Model with mathematics. 5 - Use appropriate tools strategically. 6 - Attend to precision. 7 - Look for and make use of structure. **8 - Look for and express regularity in repeated reasoning.**
Science	Physical Sciences HS-PS1 Matter and Its Interactions HS-PS2 Motion and Stability: Forces and Interactions HS-PS3 Energy HS-PS4 Waves and Their Applications in Technologies for Information Transfer Earth and Space Sciences HS-ESS3 Earth and Human Activity Engineering, Technology, and Applications of Science HS-ETS1 Engineering Design HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

	HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environment HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Science and Engineering Practices 1. Asking questions and defining problems 2. Developing and using models 3. Planning and carrying out investigations 4. Analyzing and interpreting data 5. Using mathematics and computational thinking 6. Constructing explanations and designing solutions 7. Engaging in argument from evidence 8. Obtaining, evaluating, and communicating information Science Crosscutting Concepts 2. Cause and effect: Mechanism and explanation. 3. Scale, proportion, and quantity. 4. Systems and system models. 5. Energy and matter: Flows, cycles, and conservation. 6. Structure and function. 7. Stability and change.

21st Century Skills		
Check those that students will demonstrate in this course:		
LEARNING & INNOVATION	**INFORMATION, MEDIA & TECHNOLOGY SKILLS**	**LIFE & CAREER SKILLS**
Creativity and Innovation ☒Think Creatively ☒Work Creatively with Others ☒Implement Innovations	**Information Literacy** ☒Access and /evaluate Information ☒Use and Manage Information	**Flexibility and Adaptability** ☒Adapt to Change ☒Be Flexible
Critical Thinking and Problem Solving ☒Reason Effectively ☒**U**se Systems Thinking ☒Make Judgments and Decisions ☒Solve Problems	**Media Literacy** ☐Analyze Media ☐Create Media Products	**Initiative and Self-Direction** ☒Manage Goals and Time ☒Work Independently ☒Be Self-Directed Learners
Communication and Collaboration ☒Communicate Clearly ☒Collaborate with Others	**Information, Communications and Technology (ICT Literacy)** ☒Apply Technology Effectively	**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