EVERETT PUBLIC SCHOOLS
PHYSICS IN THE UNIVERSE

Course: Pre-Engineering Technologies	**Total Framework Hours:** 180
CIP Code: 140102 ☒Exploratory ☐Preparatory	**Date Last Modified:** 07.2020
Career Cluster: Science, Technology, Engineering and Math	**Cluster Pathway:** Engineering and Technology

Industry-Recognized Certificates:

Work-Based Learning:

Course Information:

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students will complete the Catapult.	
Leadership Alignment:	
Standards and Competencies	
Unit: Forces and Motion	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 22
• Standard 6: Students will develop Abilities for a Technological World. This includes becoming able to: • Apply the design process. • Assess the impact of products and systems. • Standard 8: Students will develop an understanding of Design. This includes knowing about: • The attributes of design. • Engineering design. • The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving • Standard 11: Students will develop abilities to apply the design process. • Identify the design problem to solve. • identify criteria and constraints and determine how these will affect the design process. • Refine a design by using prototypes and modeling. • Evaluate the design solution using conceptual, physical and mathematical models at various intervals of the design process. • Develop and produce a product. • Evaluate final solutions and communicate observation, processes, and results.	
Aligned Washington State Learning Standards	

English Language Arts	Below are possible standards for 9-10 Technical Standards in ELA.. Pick the standards that are intentional taught with the physics. Key Ideas and Details: CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. CCSS.ELA-LITERACY.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. CCSS.ELA-LITERACY.RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text. Craft and Structure: CCSS.ELA-LITERACY.RST.9-10.4 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 grades 9-10 texts and topics. CCSS.ELA-LITERACY.RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). CCSS.ELA-LITERACY.RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. Integration of Knowledge and Ideas: CCSS.ELA-LITERACY.RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. CCSS.ELA-LITERACY.RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. CCSS.ELA-LITERACY.RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. Range of Reading and Level of Text Complexity: CCSS.ELA-LITERACY.RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.
Mathematics	Use functions to model relationships between quantities CCSS.MATH. CONTENT.8. F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. Create equations that describe numbers or relationship Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R
Science	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.

	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 tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students will complete the Helmet Design and Airbag performance task	
Leadership Alignment:	
Standards and Competencies	
Unit: Collisions and Momentum	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 22
• Standard 8: Students will develop an understanding of Design. This includes knowing about: • The attributes of design. • Engineering design. • The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving • Students will develop Abilities for a Technological World. This includes becoming able to: • Apply the design process. • Assess the impact of products and systems.	
Aligned Washington State Learning Standards	
Mathematics	CCSS.MATH.CONTENT.8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
Science	HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. 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-ETS1-4 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
Performance Assessments: • Students will
Leadership Alignment:
Standards and Competencies
Unit: Forces at a Distance

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 22
• Standard 6: Students will develop an understanding of the role of society in the development and use of technology • The role of society on the development and use of technology. • The influence of technology on society • Standard 7: Students will develop an understanding of the designed world. This includes selecting and using. • Agricultural and related Biotechnologies • Information and communication technologies • Construction technologies • Medical technologies • Energy and Power technologies • Transportation technologies • Manufacturing technologies	
Aligned Washington State Learning Standards	
Mathematics	Use functions to model relationships between quantities CCSS.MATH.CONTENT.8.F.B.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. Create equations that describe numbers or relationship Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R
Science	HS-PS2-4 Use mathematical representations of Newton's law of gravitation and Coulomb's law to describe and predict the gravitational and electrostatic forces between objects. HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students will complete the Rube Goldberg Machine.	
Leadership Alignment:	
Standards and Competencies	
Unit: Energy Conversions	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 22
• Standard 5: Students will develop an understanding of Design. This includes knowing about: • The attributes of design. • Engineering design. • The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. • Standards 6: Students will develop Abilities for a Technological World. This includes becoming able to: • Apply the design process.	
Aligned Washington State Learning Standards	
Mathematics	CSS.MATH.CONTENT.8.F.B.4

	Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
Science	HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Students will

Leadership Alignment:

Standards and Competencies

Unit: Electricity and Magnetism

Industry Standards and/or Competencies | **Total Learning Hours for Unit:** 22

- Standard 4: Students will develop an understanding of Technology and society. This includes knowing about:
- The effects of technology on the environment
- The role of society in the development and use of technology
- The influence of technology on history
- Standard 6: Students will develop Abilities for a Technological World. This includes becoming able to:
- Apply the design process.
- Assess the impact of products and systems.

Aligned Washington State Learning Standards

Science	HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS3-2 Develop and use a model to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects). HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in of the objects due to the interaction. energy HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

COMPONENTS AND ASSESSMENTS

Performance Assessments: • Students will
Leadership Alignment:

Standards and Competencies	
Unit: Nuclear Processes	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 22
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Aligned Washington State Learning Standards	
Science	HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. HS-ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. HS-ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history. HS-ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

COMPONENTS AND ASSESSMENTS
Performance Assessments: • Students will
Leadership Alignment:

Standards and Competencies	
Unit: Waves	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 24
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Aligned Washington State Learning Standards	
Mathematics	Create equations that describe numbers or relationships. CCSS.MATH.CONTENT.HSA.CED.A.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. CCSS.MATH.CONTENT.HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R. Define, evaluate, and compare functions. CCSS.MATH.CONTENT.8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s2giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.
Science	HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media HS-PS4-2 Evaluate questions about the advantages of using digital transmission and storage of information.

	HS-PS4-3 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy. HS-ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

COMPONENTS AND ASSESSMENTS	
Performance Assessments: • Students will	
Leadership Alignment:	
Standards and Competencies	
Unit: Stars and the Universe	
Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 24
• Students will develop an understanding of the influence of technology on history. • The evolution of civilization has been directly affected by, and in turn has affected, the development and use of tools and materials.	
Aligned Washington State Learning Standards	
Science	HS-ESS1-1 Develop a model based on evidence to illustrate the lifespan of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. HS-ESS1-2 Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe. HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements. HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

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 **Critical Thinking and Problem Solving** ☐Reason Effectively ☐**U**se Systems Thinking ☐Make Judgments and Decisions ☐Solve Problems **Communication and Collaboration** ☐Communicate Clearly ☐Collaborate with Others	**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	**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