EVERETT PUBLIC SCHOOLS
8TH GRADE SCIENCE

Course: Pre-Engineering Technologies in Science (Gr 8 Science)		**Total Framework Hours:** 120
CIP Code: 140102	☒**Exploratory** ☐**Preparatory**	**Date Last Modified:** 03.2022
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: • plan and carry out investigations and analyze and interpret data to figure out that all solid objects behave elastically up to a point and that the forces between objects in a collision are always equal in size and opposite in direction. • develop and use free body diagram models to represent the changes in the relative strength of forces on different objects in a collision. • create and use mathematical models to determine how changes in the mass and speed of an object affect the amount of kinetic energy that object has. • develop and use system models to support explanations for how contact forces, including friction and air resistance, cause energy to be transferred from one part of the system to another before, during, and after a collision. • plan and carry out investigations to determine which cushioning materials reduce peak forces the most in a collision. • develop macroscopic models of small and microscopic structures of these materials and use these to generate data about how space to deform, contact time in a collision, and peak forces in a collision are related. • carry out investigations and analyze data about how the shape and size of cushioning materials affect force distribution in a cushioning structure. • identify trade-offs, analyze, and critique design solutions, and optimize designs solutions using evidence from these investigations to solve different design problems for different stakeholders and different contexts.
Leadership Alignment: Students have opportunities to use, build upon and critique other's ideas. Students use evidence to support ideas, ask for evidence from others, and suggest ways to get additional evidence. Students have several opportunities to give and get feedback. Students engage in science and engineering practices in meaningful ways in order to make progress on their questions. Students' ideas and questions determine what evidence to collect. Students seek and use evidence to figure something out as they build and revise their explanations, models and arguments. The class community values the diversity of resources students bring to science class, including language, gestures, metaphors, and various modes of expression. Norms are established and revisited to support equitable sensemaking.

Competitive Events:
Technology Student Association – Structural Engineering

Standards and Competencies

Unit: Why do some things get damaged when they hit each other? (8.1)

Industry Standards and/or Competencies | **Total Learning Hours for Unit:** 30

- **Standard 1. Students will develop an understanding of the characteristics and scope of technology.**
- F. New products and systems can be developed to solve problems or to help do things that could not be done without
- G. The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative
- H. Technology is closely linked to creativity, which has resulted in innovation.
- I. Corporations can often create demand for a product by bringing it onto the market and advertising it.
- **Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.**
- D. Technological systems often interact with one another.
- E. A product, system, or environment developed for one setting may be applied to another setting.
- F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.
- **Standard 5. Students will develop an understanding of the effects of technology on the environment.**
- The management of waste produced by technological systems is an important societal issue.
- **Standard 8. Students will develop an understanding of the attributes of design.**
- E. Design is a creative planning process that leads to useful products and systems.
- F. There is no perfect design.
- G. Requirements for a design are made up of criteria and constraints.
- **Standard 9. Students will develop an understanding of engineering design.**
- F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.
- 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.
- H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
- **Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.**
- F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system.
- 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.
- H. Some technological problems are best solved through experimentation
- **Standard 11. Students will develop abilities to apply the design process.**
- H. Apply a design process to solve problems in and beyond the laboratory-classroom.
- I. Specify criteria and constraints for the design.
- J. Make two-dimensional and three-dimensional representations of the designed solution.
- K. Test and evaluate the design in relation to preestablished requirements, such as criteria and constraints, and refine as needed.

Aligned Washington State Learning Standards

English Language Arts	CCSS.ELA-LITERACY.W.8.1 Write arguments to support claims with clear reasons and relevant evidence CCSS.ELA-LITERACY.W.8.1.A Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. CCSS.ELA-LITERACY.W.8.1.B Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.

	CCSS.ELA-LITERACY.W.8.1.C Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. CCSS.ELA-LITERACY.SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. CCSS.ELA-LITERACY.SL.8.1.A Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. CCSS.ELA-LITERACY.SL.8.1.B Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. CCSS.ELA-LITERACY.SL.8.1.C Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. CCSS.ELA-LITERACY.SL.8.1.D Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented. CCSS.ELA-LITERACY.RST.6-8.3 Precisely follow a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
Mathematics	7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing, and reproducing a scale drawing at a different scale. 7.RP.A.2 Recognize and represent proportional relationships between quantities. 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). 8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP4 Model with mathematics. CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. CCSS.MATH.PRACTICE.MP6 Attend to precision. CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.
Science	MS-PS2-1: Apply Newton’s Third Law to design a solution to a problem involving the motion of two colliding objects. MS-PS2-2: Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object. MS-PS3-1: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. MS-LS1-8: Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate

	behavior or storage as memories. MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

COMPONENTS AND ASSESSMENTS

Performance Assessments:

- Students will:
- By investigating factors including loudness and pitch, students develop a model of vibration that captures important ideas about how changes in the frequency and amplitude of the vibrations that can explain these different characteristics of sounds. Students use this model of vibration to answer their initial questions about what causes different sounds.
- By testing various types of materials and using interactive computer models, students figure out how sound travels from one location to another by causing sequences of vibrations through matter. What they figure out helps students answer their initial questions about how sound is traveling from a sound source to our ears.
- By reasoning with the models, they have developed, students also figure out how sounds can be absorbed and transmitted. In particular, they figure out how the energy transferred by the sound wave depends on both frequency and amplitude of a sound wave and is more affected by its amplitude than the frequency. What students figure out helps them answer their initial questions about how objects that are not touching a sound source can shake in response to sound.

Leadership Alignment:

- Students have opportunities to use, build upon and critique other's ideas.
- Students use evidence to support ideas, ask for evidence from others, and suggest ways to get additional evidence.
- Students have several opportunities to give and get feedback.
- Students engage in science and engineering practices in meaningful ways in order to make progress on their questions.
- Students' ideas and questions determine what evidence to collect.
- Students seek and use evidence to figure something out as they build and revise their explanations, models and arguments.
- The class community values the diversity of resources students bring to science class, including language, gestures, metaphors, and various modes of expression.
- Norms are established and revisited to support equitable sensemaking.

Competitive Events:
Technology Student Association – Structural Engineering

Standards and Competencies

Unit: How can a sound make something move? (8.2)

Industry Standards and/or Competencies	**Total Learning Hours for Unit:** 30

- **Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.**
- D. Technological systems often interact with one another.
- F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.
- **Standard 9. Students will develop an understanding of engineering design.**
- F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.
- 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.
- H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
- **Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and**

experimentation in problem solving. • H. Some technological problems are best solved through experimentation • **Standard 11. Students will develop abilities to apply the design process.** • J. Make two-dimensional and three-dimensional representations of the designed solution.	
Aligned Washington State Learning Standards	
English Language Arts	CCSS.ELA-LITERACY.W.8.1 Write arguments to support claims with clear reasons and relevant evidence CCSS.ELA-LITERACY.W.8.1.A Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. CCSS.ELA-LITERACY.W.8.1.B Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text. CCSS.ELA-LITERACY.W.8.1.C Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. CCSS.ELA-LITERACY.SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. CCSS.ELA-LITERACY.SL.8.1.A Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. CCSS.ELA-LITERACY.SL.8.1.B Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. CCSS.ELA-LITERACY.SL.8.1.C Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. CCSS.ELA-LITERACY.SL.8.1.D Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented. CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
Mathematics	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). 8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). 6.RP.A.2 Understand the concept of a unit rate a/b associated with a ratio a:b with b ≠ 0 and use rate language in the context of a ratio relationship. 6.SP.B.5

	Summarize numerical data sets in relation to their context, such as by: 6.SP.B.5.A Reporting the number of observations. 6.SP.B.5.B Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. 6.SP.B.5.C Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. 6.SP.B.5.D Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. 7.RP.A.2 Analyze proportional relationships and use them to solve real-world and mathematical problems. 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. 8.F.A.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP4 Model with mathematics. CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. CCSS.MATH.PRACTICE.MP6 Attend to precision. CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.
Science	MS-PS4-1: Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

COMPONENTS AND ASSESSMENTS
Performance Assessments: • Through a series of hands-on investigations, students • deconstruct and rebuild a technological tool, to investigate how parts of the system interact • develop and refine a model about forces (pushes and pulls) that includes magnetic forces interacting at a distance via fields that extend through space, • revise a model for explaining magnetic forces to include electromagnets that act as permanent magnets in many ways but can be manipulated by changing the electric current, • consider the transfer of energy in their model, and the connections between forces, energy and magnetic fields, • design, plan and carry out a series of investigations to test how changes in one part of a magnetic system (e.g., number of coils, diameter of coils, strength of magnet) affect the magnetic forces in the system, and • construct an explanation based on evidence to explain that magnetic fields extend through space and predict the strength and direction of magnetic forces.

Leadership Alignment:
Students have opportunities to use, build upon and critique other's ideas.
Students use evidence to support ideas, ask for evidence from others, and suggest ways to get additional evidence.
Students have several opportunities to give and get feedback.
Students engage in science and engineering practices in meaningful ways in order to make progress on their questions.
Students' ideas and questions determine what evidence to collect.
Students seek and use evidence to figure something out as they build and revise their explanations, models and arguments.
The class community values the diversity of resources students bring to science class, including language, gestures, metaphors, and various modes of expression.
Norms are established and revisited to support equitable sensemaking.

Competitive Events:
Technology Student Association – Electrical Applications

Standards and Competencies

Unit: How can a magnet move another object without touching it? (8.3)

Industry Standards and/or Competencies | **Total Learning Hours for Unit:** 30 hours

- **Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.**
- D. Technological systems often interact with one another.
- F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.
- **Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.**
- H. Some technological problems are best solved through experimentation
- **Standard 11. Students will develop abilities to apply the design process.**
- J. Make two-dimensional and three-dimensional representations of the designed solution.

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Mathematics	CCSS.Math.Content.7.PR.1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. CCSS.Math. Content.6.NS.C.8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP4 Model with mathematics. CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. CCSS.MATH.PRACTICE.MP6 Attend to precision. CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.
Science	MS-PS2-3: Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. MS-PS2-5: Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. MS-PS3-2: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

COMPONENTS AND ASSESSMENTS
Performance Assessments: • Students will: • Develop and use both physical and conceptual models of objects in space to explain seasonal temperature variation across the globe, lunar phases, lunar eclipses, solar eclipses, and transits of Venus and Mercury. • Attend explicitly to the perspective taken by the observer in their systems models and eventually include multiple perspectives at various scales, beginning here on Earth and expanding out to include the solar system and galactic scales. • Use simulations to look for patterns of objects over time, including carrying out experiments on how the part of the Moon that is visible at a particular part of a lunar month is related to the position of the Moon related to the Earth and a person on Earth and the factors that influence the orbits of one object around another. • Analyze, interpret, and collect data about objects in the solar system in order to gather evidence to explain the patterns we see in the sky and space with both our unaided eyes and from telescopes and spacecraft, as well as results from a computer simulation of the formation of the solar system • Investigate phenomena and develop a model of light that can account for changes in color and brightness when it interacts with matter, and then revise a lunar

eclipse model to represent the Earth-Sun-Moon system and that the matter in Earth's atmosphere selectively absorbs and bends light from the Sun to color the Moon red.

- Obtain information about objects in the sky and space that connect to observations made by other cultures and people throughout history.

Leadership Alignment:
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Competitive Events:
Technology Student Association – Challenging Technology Issues

Standards and Competencies

Unit: How are we connected to the patterns we see in the sky and space? (8.4)

Industry Standards and/or Competencies | **Total Learning Hours for Unit:** 30

- **Standard 4. Students will develop an understanding of the cultural, social, economic, and political effects of technology.**
- G. Economic, political, and cultural issues are influenced by the development and use of technology.
- **Standard 9. Students will develop an understanding of engineering design.**
- F. Design involves a set of steps, which can be performed in different sequences and repeated as needed.
- 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.
- H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
- **Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.**
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- J. Make two-dimensional and three-dimensional representations of the designed solution.

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Mathematics	CCSS.MATH.CONTENT.7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. CCSS.MATH.CONTENT.7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units. CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them. CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively. CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others. CCSS.MATH.PRACTICE.MP4 Model with mathematics. CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically. CCSS.MATH.PRACTICE.MP6 Attend to precision. CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.
Science	MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS4-2: Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. MS-ESS1-1: Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. MS-ESS1-2: Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-3: Analyze and interpret data to determine scale properties of objects in the solar system.

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