Everett Public Schools Framework: Energy, Machines, and Motion

Course: Pre-Engineering Technologies	**Total Framework Hours:** 60 Hours
CIP Code: 140102	**Type:** Exploratory
Career Cluster: Science, Technology, Engineering and Math	**Date Last Modified:** Monday, January 06, 2014

Resources and Standard used in Framework Development:

Standards used in this framework are taken from the OSPI Model Framework for 140102 Pre-Engineering Technologies

Unit 1 FORCES, KINEMATICS, AND NEWTON'S LAWS — Hours: 60

Performance Assessment(s):

Students will pass exams with 60% or better on all competency standards for the course. System thinking is assessed through the projects and the successful completion of lab notebooks.

Lab/Engineering Based Performance Assessments:
Students explore several mechanical systems and analyze the energy transformations within the system. Forces are identified and the resulting effects of motion are determined.

Students explore the mechanical advantage of three different simple machines and determine efficiency. Students apply this knowledge to design a machine that combines two or three simple machines to solve a problem.

Student observe the motion of a roller coaster resulting from the changes in vertical height as a cart moves along the track. Gravitational and potential energy are studied as potential energy is converted to kinetic energy. Students gain an understanding of the conservation of energy as they conduct these inquires. A new roller coaster is designed that meets a design challenge.

Students build a mousetrap car from k'nex and study the energy transformations that power the car. They then study the motion by timing the distance the car travels along a track. Student design modifications to increase the distance the car travels. A cost analysis is conducted to analyze the economic variables of vehicle production.

Leadership Alignment:

Students work in groups to build a mousetrap car from k'nex and study the energy transformations that power the car. Student design modifications to increase the distance the car travels. A cost analysis is conducted to analyze the economic variables of vehicle production.

Associated CTSO: middle school robotics (TSA)

Standards and Competencies

C-3 Standard: Students will develop an understanding of the attributes of design and apply them to develop and produce a product.

C-3.1 Students will show their understanding of the design process by performing the steps involved: defining the problem, brainstorming and researching to come up with ideas, identifying criteria and specifying constraints, exploring ideas, selecting an approach, coming up with a design and making a proto-type model, testing and evaluating the design and refining if necessary, and communicating processes and results.

C-3.3 Students will use their knowledge of hand tool and power machinery usage to create a materials list and steps-of-procedure document to communicate processes in building their product.

C-3.5 Product designer and builder will meet to discuss and fill out an evaluation sheet summarizing how well they feel they did on their part of the product development.

C-3.6 Students will participate in a discussion about all the types of design careers there are and the job titles and functions of those who may be involved in design.

C-3.7 Applying organizational skills and time management will be required to finish the unit work in a timely manner.

C-5 Standard: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

C-5.1 Understand and apply concepts of velocity, acceleration, force, kinetic energy, potential energy, and rolling drag.

C-5.2 Applying learned knowledge of Newton's three laws of motion in designing the car.

C-5.3 Understand and utilize relevant vocabulary (circumference, diameter, Pi, bearing, lever, axel, sprocket, friction, and rolling drag).

C-5.4 Use all machines and tools in accordance with all safety regulations (Miter Saw, Drill Press, Band Saw, Power Sanders, Scroll Saw, and others required) to complete the performance assessment.

C-5.5 Successfully perform the following tasks: formulate ideas, create a sketch, complete a front and top view drawing with parts labeled, create a materials list, construct and test, make any necessary modifications, complete calculation sheet to estimate how far the car will travel, participate in the Mousetrap-Snap-Off contest, and complete the car evaluation report.

C-5.6 Demonstrate technical writing, testing, data collection and math skills by completing the mousetrap car evaluation sheet.

C-5.7 Applying organizational skills and time management will be required to finish the unit work in a timely manner.

C-7 Standard: Students will develop an understanding of the influence of technology on history.

C-7.1 Demonstrate the completion of the following engineering design process steps: define the problem, generate ideas, select a solution, test the solution(s), build the item, evaluate it, and report the results.

C-7.2 Applying learned knowledge of Newton's three laws of motion in designing and explaining function of the trebuchet.

C-7.3 Apply their understanding of simple machines/levers and explain that the trebuchet is an example of a Class 1 lever.

C-7.4 Demonstrate sketching ability by creating 4 different sketch ideas of trebuchet designs with the different parts labeled.

C-7.7 Use all machines and tools in accordance with all safety regulations (Miter Saw, Drill Press, Band Saw, Power Sanders, Scroll Saw, and others required) to complete the performance assessment.

C-7.8 Demonstrate technical writing, testing, data collection and math skills by completing the trebuchet evaluation sheet.

C-7.9 Applying organizational skills and time management will be required to finish the unit work in a timely manner.

C-8 Standard: Students will develop an understanding of the core concepts of technology.

C-8.1 Apply an understanding and knowledge of simple machines by including them in the design of their pinball machine.

C-8.2 Applying learned knowledge of Newton's three laws of motion in designing and explaining function of the pinball machine (ball movement).

C-8.3 Demonstrate the completion of the following engineering design process steps: define the problem, generate ideas, select a solution, test the solution(s), build the item, evaluate it, and report the results.

C-8.4 Produce sketch drawings and a full size pattern drawing of the pinball machines game's playing surface.

C-8.5 Use all machines and tools in accordance with all safety regulations (Miter Saw, Drill Press, Band Saw, Power Sanders, Scroll Saw, and others required) to complete the performance assessment.

C-8.6 Examine and apply specific criteria in the design and production of the pinball machine.

C-8.7 Applying organizational skills and time management will be required to finish the unit work in a timely manner.

C-8.8 Apply writing skills to complete the evaluation summary worksheet that explains how their pinball machine works and how it performed.

Aligned to Washington State Standards

Arts

Communication - Speaking and Listening

Health and Fitness

Language

Mathematics

CC: Mathematical Practices (MP)

MP.1 Make sense of problems and persevere in solving them. Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and go

MP.2 Reason abstractly and quantitatively. Mathematically proficient students make sense of the quantities and their relationships in problem situations. Students bring two complementary abilities to bear on problems involving quantitative relationships:

MP.3 Construct viable arguments and critique the reasoning of others. Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a l

MP.4 Model with mathematics. Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to descri

MP.5 Use appropriate tools strategically. Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet

MP.6 Attend to precision. Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including usin

MP.7 Look for and make use of structure. Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a

MP.8 Look for and express regularity in repeated reasoning. Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that th

Reading

CC: Reading Informational Text

Key Ideas and Details:

RI.6.1 Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

RI.6.2 Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.

Craft and Structure:

RI.6.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.

RI.8.5 Analyze in detail the structure of a specific paragraph in a text, including the role of particular sentences in developing and refining a key concept.

RI.8.6 Determine an author's point of view or purpose in a text and analyze how the author acknowledges and responds to conflicting evidence or viewpoints.

Integration of Knowledge and Ideas:

RI.6.7 Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

RI.6.8 Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

Range of Reading and Level of Text Complexity:

RI.6.10 By the end of the year, read and comprehend literary nonfiction in the grades 6–8 text complexity band proficiently, with scaffolding as needed at the high end of the range.

Science

Science Crosscutting Concepts

1. Patterns.
2. Cause and effect: Mechanism and explanation.
4. Systems and system models.
5. Energy and matter: Flows, cycles, and conservation.

Physical Sciences

MS-PS2 Motion and Stability: Forces and Interactions

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 Energy

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-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.

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the motion energy of an object changes, energy is transferred to or from the object

MS-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

Engineering, Technology, and Applications of Science

MS-ETS1 Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit

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.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Social Studies

Writing

CC: Writing for Literacy in History/Social Studies, Science, and Technical Subjects

Text Types and Purposes:

WHST.6-8.1 Write arguments focused on discipline-specific content.

WHST.6-8.1b Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

WHST.6-8.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

WHST.6-8.2a Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and mul

WHST.6-8.2f Provide a concluding statement or section that follows from and supports the information or explanation presented.

Production and Distribution of Writing:

WHST.6-8.6 Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Research to Build and Present Knowledge:

WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

WHST.6-8.9 Draw evidence from informational texts to support analysis reflection, and research.

Range of Writing:

WHST.6-8.10 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.

21st Century Skills

LEARNING AND INNOVATION

Creativity and Innovation
- [x] Think Creatively
- [x] Work Creatively with Others
- [x] Implement Innovations

Creative Thinking and Problem Solving
- [x] Reason Effectively
- [x] Use Systems Thinking
- [x] Make Judgements and Decisions
- [x] Solve Problems

Communication and Collaboration
- [x] Communicate Clearly
- [x] Collaborate with Others

INFORMATION, MEDIA AND TECHNOLOGY SKILLS

Information Literacy
- [ ] Access and Evaluate Information
- [ ] Use and Manage Information

Media Literacy
- [ ] Analyze Media
- [ ] Create Media Products

Information, Communications, and Technology (ICT Literacy)
- [x] Apply Technology Effectively

LIFE AND CAREER SKILLS

Flexibility and Adaptability
- [x] Adapt to Change
- [x] Be Flexible

Initiative and Self-Direction
- [x] Mange Goals and Time
- [x] Work Independently
- [x] Be Self-Directed Learners

Social and Cross-Cultural
- [x] Interact Effectively with Others
- [x] Work Effectively in Diverse Teams

Productivity and Accountability
- [x] Manage Projects
- [x] Produce Results

Leadership and Responsibility
- [x] Guide and Lead Others
- [x] Be Responsible to Others