Technology and Engineering Curriculum Map	**Course Description:** The purpose of this course is to introduce students to the world of technology and engineering as the first step in becoming technologically literate citizens. Through real-world connections and hands-on activities, all students will have the opportunity to see how science, math, and engineering are part of their everyday world, and why it is important for every citizen to be technologically and scientifically literate. **Length of Course:** One Year/Two Semesters	
Unit 1 **Manufacturing and Designing** **Timeline: first quarter** **Essential Questions**	What is engineering and the engineering design process (EDP)? What makes something 'technology"? How do engineers develop technologies to meet human needs and wants?	
Standards	1.1 Identify and explain steps of the engineering design process. The design process steps are identify the problem; research the problem; develop possible solutions; select the best possible solution(s); construct prototypes and/or models; test and evaluate; communicate the solutions; and redesign 1.2 Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify and explain examples of technologies, objects, and processes that have been modified to advance society 1.3 Produce and analyze multi-view drawing (orthographic projections) and pictorial (isometric, oblique, perspective) drawings using various techniques 1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings, such as, ⅛" = 1'0", 1cm = 1m 1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models. 2.5 Identify and demonstrate the safe and proper use of common hand tools and/or power tools and measurement devices used in construction. 7.1Describe the manufacturing process of casting and molding, forming, separating, conditioning, assembling, and finishing. 7.2 Identify the criteria necessary to select the tools and procedures used in the safe production of products in the manufacturing process, such as material properties required tolerances, and end-uses.	
Concepts and Skills	➢ Technology is essential for improvement of life ➢ Compare and contrast the work of engineers and scientists ➢ The importance of research ➢ The construction of a mock-up is essential before a final product or prototype ➢ The steps and stages of the Engineering Design Process (EDP) ➢ Create scale drawings	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Common Core Reading Standards** CCRSL.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

	➢ Classify drawings by type ➢ Use appropriate tools to measure and construct ➢ Work as a team	accurate summary of the text. CCRSL.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. CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **Common Core Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	• Define technology in everyday terms. • Describe how engineers solved a complex problem in a developing country based on a reading. • Give examples of technology found in the home. • Describe what engineers “do”. • Reflect on whether it is better to have a profitable invention, or an invention that helps people. • Define the problem associated with creating a cell phone holder, including criteria and constraints. • Analyze scale diagrams/models to solve problems and support explanations	

	• Create a 3-D model from a scale drawing • Create a scale diagram of the organizer solution • Use the EDP process and the PUGH chart to construct and redesign a mock-up of the organizer • Contrast mass vs. niche marketing
Assessments/ Products/Practices	**Quick Labs/Demonstrations/Projects/Practices:** Benchmark Assessments on p. 8 & p. 18 in Project 1.0 Notebook related to the "Cell Phone Holder" Design Drawings of cell phone holder Cell phone holder prototypes Benchmark on p. 20-28 in Project 1.0 Notebook Benchmark assessments for 1.4 (p. 46) and 1.5 (p. 52) in the Project 1.0 Notebook The "Best Organizer" project Drawings of possible solutions for the organizer Quiz on "Engineering Skills" including measuring, calculating area, and using the EDP to solve problems. Quiz on "Tools and Manufacturing" Quiz on "Engineering Drawing" Chapter questions and discussion **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others? Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Technology and Engineering MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Engineering the Future

	book.
Texts, Materials, and Resources	**Engineering the Future textbook:** Chapter 1 Welcome to the Designed World - Technology & Engineering Chapter 2 Birth of a New Technology - How Things Are Invented Chapter 3 Designs That Take Flight - The Design Process Chapter 4 Beyond Words - Engineering Drawing Chapter 5 The Art of Engineering - Teamwork Chapter 6 Bringing Designed Ideas to the Market Chapter 7 A Universe of Systems - Systems Analysis Chapter 8 The Making of New Balance Shoe - The Manufacturing Processes **Engineering the Future Notebook:** 1.1 What is Engineering? 1.2 Design a Cell Phone Holder 1.3 Engineering Drawing 1.4 Define the Problem 1.5 Research the Problem 1.6 Develop Possible Solutions 1.7 Choose the Best Solution 1.8 Create a Prototype 1.9 Test and Evaluate 1.10 Communicate the Solution 1.11 Redesign **Websites:** "Design that Matters" **Video:** "Amy Smith: Simple designs that could save millions of children's lives" (15:46) "Shawn Frayne: The Power of Appropriate Technology" (1:10) "Bill Nye: Scientific Advancements" (55:56) ABC Nightline "The Deep Dive" (IDEO Shopping Cart) Available on DVD or in segments on YouTube. (~25 min)

	"The History of Apple & Steve Jobs" (5:57) Google Sketchup (Free CAD Software) Print Free Graph Paper.com EtF Technical Drawing Flash Module EtF Project 1 Quick Tip Video: "Engineering Drawing" (1:53) EtF Project 1 Quick Tip Video: "Scale" (1:25) "Visit the Matchbox Car Factory" (6:32) *This video is intended for younger students but would be interesting/informative for older students as well. "Market Researcher" (5:04) "Prototype This: Traffic Buster" (41:22) [& other episodes in this series involve engineers using the EDP to innovate.] "Workshop Safety" (12:03) [Graphic, focuses on woodshops.] EtF Project 1 Quick Tip Video: "Manufacturing Processes" (1:08) "Project 500: Modern Manufacturing" (12:25) [Short segments on how croissants, puzzles, and gravel are manufactured.] **Website:** Stanford University's Alliance for Innovative Manufacturing: How Everyday Things Are Made. Technology and Engineering MCAS tests from previous years
Vocabulary	Tier three vocabulary: appropriate technology, constraints, criteria, engineer, engineering design process, mock-up, prototype, scientist, technology, CAD, dimensions, isometric, mass marketing, niche marketing, oblique, orthographic, perspective, ratio, scale, casting, molding, forming, finishing, conditioning Tier two procedural words: production, process, patent, data, application, prevent, regulate, durable, storage, transfer, brainstorm, specifications, modification, advance, develop, distribute, survey, scenario, produce, market, evaluate, redesign, refine, mass-produce, projection, represent, produce, diagram, square footage, vertical, support, column, mechanical, machinist, diameter, model, mechanism, correspond, material, process, production, inspect, feed, maintenance, consider, suggest, profitable, exposure, adhesive, pour, imprint
Unit 2 **Cities and Buildings** **Timeline: 2nd quarter** **Essential Questions**	How do designers develop structures and systems that last? How is the work of engineers different from the work of scientists? How do designers preserve more of the natural world and promote the health and well-being of residents?

Standards	1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models 2.1 Identify and explain the engineering properties of materials used in structures, such as, elasticity, plasticity, R value, density, and strength 2.2 Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures. 2.3 Explain Bernoulli's principle and its effect on structures, such as buildings and bridges. 2.4 Calculate the resisting force(s) for a combination of live loads and dead loads 2.6 Recognize the purpose of zoning laws and building codes in the design and use of structures 4.1 Differentiate among conduction, convection and radiation in a thermal system, such as, heating and cooling a house and cooking 4.2 Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system 4.3 Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings 4.4 Identify and explain alternatives to nonrenewable energies, such as wind and solar energy conversions systems	
Concepts and Skills	➢ Structural components that contribute to load and stress. ➢ Factors that reflect a new urbanist's approach to city planning. ➢ Importance of using EDP to design structures ➢ The importance of geo-technical engineering and green architecture ➢ Use models to generate data to support explanations and solve problems	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Common Core Reading Standards** CCRSL.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. CCRSL.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. CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **Common Core Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple

		samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	• Describe how city planners are implementing ideas including sustainable development and new urbanism based on a reading. • Identify a problem associated with urban sprawl and possible solutions. • Identify several local building codes or zoning laws. • Classify loads based on their permanence (live vs. dead loads). • Use EDP to design a model of a deck • Describe Bernoulli's principle and how it relates forces and structures • Classify materials based on their properties	
Assessments/ Products/Practices	**Quick Labs/Demonstrations/Projects/Practices:** Construct a model of a deck and evaluate its ability to support loads. Defend the deck design through writing or an oral presentation. Solve a problem related to loads by performing calculations such as area, volume, and safety factor. Complete a sample building permit Complete the "Tower Project Report" Quiz on "Forces and Materials" Complete the benchmark assessment on p. 20, 42. Complete the written report related to the concrete experiment. Quiz on "Forces & Materials", "Loads and Codes", "Thermal Energy." Write a report that includes the results of the insulation experiment.	

	Quiz on Complete a scale drawing of the building design and a scale model of the building that students design. **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others? Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Technology and Engineering MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Engineering the Future book
Texts, Materials, and Resources	**Engineering the Future textbook:** Chapter 10 Redesigning America - Urban Planning Chapter 11 Bridging the Future - Structures and Loads Chapter 12 Tower in the Sky - Materials and Forces Chapter 14 From the Ground Up - Climate and Soil Chapter 15 Building Green - Energy Efficiency Chapter 21 Energy from the Earth Chapter 16 A Race for the Sun - Active and Passive Solar Heating Chapter 13 Home Sweet Home **Engineering the Future Notebook:** 2.1 Define the Problem 2.2 Identify the Loads the Building Must Support 2.3 Use Failure Analysis to Design a Safer Building 2.4 Test Construction Materials for Strength

	2.5 Describe Mechanical Properties of Materials 2.6 Experiment with Concrete 2.7 Make Your Building Energy Efficient 2.8 Make a Scale Drawing of Your Building Design **Video:** "Topics and Issues in Environmental Science: Spin on Sprawl" (20:11) [Video follows younger students, but short segments cover many aspects of urban sprawl.] "Ecopolis: Ultimate Ecopolis" (44:34) [Part of a series that looks at problems and solutions for megacities of the future.] "Extreme Engineering: Boston's Big Dig" (49:32) [Filmed in 2003, before the project was complete.] EtF Project 2 Quick Tip Video: "Loading & Stress" (0:53) "Seconds from Disaster: Skywalk Collapse" (45:54) [Biggest engineering disaster in US history. Policy changes resulted.] "Structure" (23:36) [Best for short segments related to each type of force.] "Understanding Bridges" (24:58) [Integrates all the forces that affect bridges.] "Bill Nye: Engineering and architecture" (55:56) [Shorter segments review tunnels, bridges, skyscrapers, and dams.] EtF Project 2 Quick Tip Video: "Compression, etc." (1:28) "Blown Away: Greensburg, Kansas" (41:09) [Does not explicitly discuss Bernoulli – but has great explanations of how wind forces from tornadoes affect structures. Uses scale models to evaluate different home designs.] "Bill Nye: The science of materials" (55:56) [Broken into short segments related to each material.] EtF Project 2 Quick Tip Video: "Crushing Concrete" (2:32) "Heat, Temperature, and Energy" (23:00) "Heat and the changing states of matter" (19:09) [Both are informative, but old.] EtF Project 2 Quick Tip Video: "Seeing & Feeling Heat" (1:15) "Go Green: Eco Insulation" (3:19) "Fiberglass Insulation" (6:34) "Denim Insulation" (5:52) EtF Project 2 Quick Tip Video: "Steady-State" (1:16) "Ecopolis: Building the Future" (44:33) [Efficient buildings in megacities of the future.] EtF Project 2 Quick Tip Video: "Solar Heating" (1:18) "How to think like an architect: The Design Process" (3:55) "How to think like an architect: Designing from nature" (2:29) **Website:** Sierra Club City of Lawrence Planning Department

	EtF Structures & Forces Flash Module
Vocabulary	Tier three words: area, building code, dead load, fastener, foundation, framing, live load, new urbanism, sustainable development, urban sprawl, volume, zoning law, bending, brittle, compression, density, ductile, elastic, malleable, plastic, porous, shear, tension, torsion, combustion, conduction, convection, insulation, nonrenewable energy, radiation, renewable energy, solar angle, R-factor, thermal expansion Tier two procedural words: weight, vent, ventilation, exert, support, represent, withstand, horizontal, welder, exposure, subject, stress, manual, flammability, weight, level, suitable, regulations, properties, characteristics, component, steel, concrete, beam, column, turbulence, lift, develop, desirable, interior, environment, condition, tint, reduce, prevent, precipitation, influence, advantageous, consider, efficient, cost-effective, exterior, heat sink, exposure, generate, reflective, absorptive, conductive, power, transfer, climate, feature, maximize, thermostat, generator, consumption, furnace, sensor, heat loss
Unit 3 **Design and Energy** **Timeline: 3rd quarter** **Essential Questions**	How do designers harness energy to meet human needs? Why do engineers construct a mock-up before a prototype?
Standards	1.1 Identify and explain steps of the engineering design process. The design process steps are identify the problem; research the problem; develop possible solutions; select the best possible solution(s); construct prototypes and/or models; test and evaluate; communicate the solutions; and redesign 1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models 2.5 Identify and demonstrate the safe and proper use of common hand tools and/or power tools and measurement devices used in construction 3.1 Explain the basic differences between open (such as, irrigation, forced hot air system, air compressors) and closed (such as forces hot water system, hydraulic brakes) fluid systems 3.2 Explain the differences and similarities between hydraulic and pneumatic systems and how each relates to manufacturing and transportation systems 3.3 Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change 3.4 Recognize that the velocity of a liquid varies inversely with changes in cross-sectional area along the path of a moving liquid in a pipe 3.5 Identify and explain sources of resistance (such as, 45 / 90 degree elbow and changes in diameter) for water moving through a pipe 4.1 Differentiate among conduction, convection and radiation in a thermal system, such as, heating and cooling a house and cooking 7.1 Describe the manufacturing process of casting and molding, forming, separating, conditioning, assembling, and finishing 7.3 Describe the advantages of using robotics in the automation of manufacturing processes, such as, increased production, improved quality and safety

Concepts and Skills	➢ Use models to generate data to support explanations and solve problems. ➢ Use tools and materials to design, evaluate, and refine a solution to a complex real-world problem. ➢ Make and defend a claim about the effectiveness of a design solution	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Common Core Reading Standards** CCRSL.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. CCRSL.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. CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **Common Core Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the

		context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	• Define a design problem that involves criteria and constraints • Collect data about a complex model of a proposed system to identify failure points or improve performance. • Record observations about a working Putt-Putt boat. Predict how the boat works and how it could be improved. • Identify the criteria for the boat design project. • Create scale drawings of the modified boat (orthographic and isometric). • Use manufacturing processes such as separating, assembling, conditioning, forming, and finishing to construct a working Putt-Putt boat. • Model hydraulic and pneumatic systems using syringes and observe the pressure changes. • Build a closed pneumatic system and a closed hydraulic system. • Contrast the behavior of closed pneumatic v. hydraulic systems. • Build an open pneumatic system and explain how you can tell that it is open. • Explain how hydraulic lifts multiply force. • Explain how hydraulic systems act as direction changers. • Calculate force (large) based on piston area and force (small). • Calculate fluid pressure using P = F/A. • Describe the stages of an engine cycle. • Explain how temperature, volume, and pressure interact in a heat engine. • Explain how diameter and shape affect fluid resistance. • Identify the advantages of using robotics in place of humans for manufacturing tasks. • Given a manufacturing scenario, write an opinion essay about whether robots or humans should be used to construct the products.	
Assessments/ Products/Practices	**Quick Labs/Demonstrations/Projects/Practices:** Complete a benchmark assessment on p. 13, 32, 42, 60. Complete benchmark assessment on p. 25-26. Quiz on “Manufacturing Processes & Robotics” Quiz on “Fluid Systems.” Redesign the Putt-Putt boat in a way that improves performance. Complete the “Patent Application” according to the criteria/rubric on p. 66-67.	

	Notebooks: ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others? Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Technology and Engineering MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Engineering the Future book
Texts, Materials, and Resources	**Text: Engineering the Future - Designing the World of the 21st Century** Chapter 17 In Deep – Buoyancy, Robotics, Hydraulics **(1.1, 3.2, 3.3)** Chapter 18 Shooting for the Moon – The Physics of Rocketry **(1.1)** Chapter 19 Fuel from the Fields – Renewable Resources Chapter 20 An Ingenious Engine – Heat Machines **(1.2, 3.1)** Chapter 23 Down the Pipes – Open Hydraulic Systems **(3.1, 3.4, 3.5)** Chapter 21 Energy from the Earth – Geothermal Power **(1.1, 4.1, 4.4, 5.1)** **Notebook:** 3.1Putt-Putt Boats and Patents 3.2 Manufacture a Putt-Putt Boat 3.3 Investigate Fluid Systems *3.4 Develop a Manufacturing Press* *3.5 Investigate Heat Engines* *3.6 The Rocket Effect* 3.7 Investigate Resistance in Pipes

	3.8 Redesign the Putt-Putt Boat 3.9 Present Your Patent **Video:** EtF Project 3 Quick Tip Video: "Super Girl" demonstrates how to build a boiler and a hull EtF Project 3 Quick Tip Video: "Manufacturing the Putt Putt Boat" (1:32) **"**Dean of Invention: Robot Revolution" (20:37) [Robots vs. human workers "Pneumatics" (4:10) [A segment of Prototype this: Boxing robots.] "The Growth of Automobiles and Trucks" (3:56) [Explains how the pneumatic tire affected the development of cars.] EtF Project 3 Quick Tip Video: "Fluid Press & Hull Die" (1:53) EtF Project 3 Quick Tip Video: "The Air Pump" (1:26) "Hydraulic Strength" (5:59) [A segment of a longer video about a transforming robot inspired by sci-fi.] *EtF Project 3 Quick Tip Video: "Boat Propulsion" (2:27)* *EtF Project 3 Quick Tip Video: "Engine Cycle" (1:48)* EtF Project 3 Quick Tip Video: "Resistance, Flow Rate
Vocabulary	Tier three vocabulary: casting, molding, forming, finishing, conditioning, robotics, Bernoulli's principle, closed fluid system, compressible, cross-sectional area, diameter, fluid resistance, force, hydraulic, pneumatic, pressure, open fluid system, velocity Tier two vocabulary: material, process, production, inspect, feed, maintenance, consider, suggest, profitable, exposure, adhesive, pour, imprint, compare, consider, allow, recycle, cylinder, piston, minimize, efficient, corrosive, compressible, multiplier, recirculate, elbow, malfunction, pressure, exert, release, force, deposit, modify, operate
Unit 4 **Electricity and Other Power Sources** **Timeline: 4th quarter** **Essential Questions**	How is electricity generated? How is electricity used to meet the technology needs of today?
Standards	4.4 Identify and explain alternatives to nonrenewable energies, such as wind and solar energy conversions systems 5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the

	instruments used to measure voltage, current, power consumption, and resistance. 5.2 Identify and explain the components of a circuit including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors 5.3 Explain the relationship between voltage, current, and resistance in a simple circuit using Ohm's law 5.4 Recognize that resistance is affected by external factors, such as temperature. 6.1 Explain how information travels through the following media: electrical wire, optical fiber, air, and space. 6.2 Differentiate between digital and analog signals. Describe how communication systems employ digital and analog technologies such as computers and cell phones 6.3 Explain how the various components and processes of a communication system function. The components are source, encoder, transmitter, receiver, decoder 6.4 Identify and explain the applications of laser and fiber optic technologies (such as, telephone systems, cable television, and photography) 6.5 Explain the application of electromagnetic signals in fiber optic technologies, and include critical angle, and internal reflection	
Concepts and Skills	➢ Use models to generate data to support explanations and solve problems. ➢ Define a design problem that involves criteria and constraints ➢ Use tools and materials to design, evaluate, and refine a solution to a complex real-world problem. ➢ Collect data about a complex model of a proposed system to identify failure points or improve performance. ➢ Make and defend a claim about the effectiveness of a design solution ➢ Produce technical writing and/or oral presentations that communicate the process of development and the design and performance of a proposed system.	SIS1. Make observations, raise questions, and formulate hypotheses. SIS2. Design and conduct scientific investigations. SIS3. Analyze and interpret results of scientific investigations. SIS4. Communicate and apply the results of scientific investigations. **Common Core Reading Standards** CCRSL.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. CCRSL.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. CCWSL.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. **Common Core Math Standards** CCSS.Math.Content.7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge

		the variation in estimates or predictions. CCSS.Math.Content.7.SP.C.6 approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. CCSS.Math.Content.8.SP.A.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. CCSS.Math.Content.8.SP.A.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.
Content Objectives	• Build a simple circuit. • Experiment with series and parallel circuits and draw conclusions about current. • Calculate voltage, current, and resistance using Ohm's Law (I = V/R). • Make predictions about voltage drop at different locations in a circuit. • Explain how factors such as temperature, material, and wire size and shape affect resistance. • Explain how increasing or decreasing the voltage and resistance affect the current. • Calculate power in watts using P = V x I and energy usage in kWh using E = P x t. • Explain how power is delivered to homes by the grid. • Describe the importance of energy efficiency. • Contrast fuses and circuit breakers. • Research energy sources such as solar cells and diesel or wind generators. • Contrast analog and digital technology. • Classify the parts of a communication system as encoder, transmitter, receiver, and decoder. • Describe a fiber optic cable how light travels through it.	
Assessments/ Products/Practices	**Quick Labs/Demonstrations/Projects/Practices:** Complete benchmark assessments on p. 13, 25-26, 38, 48, 70 Build a "Mouse Detector" and explain how it works. Quiz on "Circuit Symbols", "Circuits", "Electrical Systems", "Communication Systems", "Manufacturing Processes & Robotics" Create a proposal for the lighthouse project based on classwork and outside research (rubric on p. 69 in section 4.7).	

	Design a communications system that will allow NASA to communicate with a station on the moon (rubric on p. 30 of section 4.3). **Notebooks:** ➢ **Content Notes (every day or close to it):** Students will identify topics; identify the main ideas and most important details and examples associated with each topic; include summaries as well as student-generated follow-up questions and answers, reflections, visualizations, and responses to the content, using higher order thinking skills (e.g., predict, connect, infer, analyze, evaluate, categorize, synthesize). ➢ **Vocabulary**: Students will highlight additional, key vocabulary in their notebooks; they will build an understanding of the vocabulary using vocabulary-development exercises (e.g., word webs, Frayer Model), as well as use the vocabulary in their daily work and conversations. ➢ **Narrative and Explanatory Essay (in response to one or more Essential and Guiding Questions)/Investigation Reports:** Student work will include evidence of planning: graphic organizers, brainstorming lists; editing of language, vocabulary, grammar, structure; organized and developed ideas utilizing precise and domain specific language; student sharing, student and teacher feedback, and revisions based on these conversations. Argumentative essays/investigation reports will include an explicit claim, scientific evidence in support of the claim (from reports, data, observations, etc.), and an explanation of how the evidence connects to and verifies the claim. ➢ **Other Sample Products:** KWL Charts. Venn Diagrams, Concept Maps, H.O.T. Boxes, Others? Every unit will end with a culminating MCAS based assessment from the DESE website and based on previous years Technology and Engineering MCAS questions. In addition extra open response questions will be presented and corrected using the MCAS grading rubric from the Engineering the Future book
Texts, Materials, and Resources	**Text: Engineering the Future - Designing the World of the 21st Century** Chapter 24 A Highway for Ideas – The Internet **(3.4, 6.2)** Chapter 25 Teaching a Machine to Listen – Computer Systems **(6.1, 6.2, 6.3, 6.4)** Chapter 26 Shedding Light on Communications **(6.2, 6.3, 6.4, 6.5)** Chapter 27 Riding the Waves - The Electromagnetic Spectrum Fibers Chapter 28 Designed learning – Mental Models of Electricity **(5.1, 5.3)** Chapter 29 On the Grid – Coal Power **(5.1, 5.2, 5.3, 6.1)** Chapter 30 Electrifying – Series and Parallel Circuits **(5.1, 5.2, 5.5)** Chapter 32 Cape Wind – Wind Power **(4.3, 4.4)** **Notebook**: 4.1 Create a Scoreboard Code 4.2 Design a Mouse Detector 4.3 Design a Communications System 4.4 Explore Circuits with an Ammeter

	4.5 Explore Circuits with a Voltmeter 4.7 Provide Energy to a Lighthouse 4.8 Analyze Consumer Electronics **Video:** "Electricity's Power: Part 2" (20:34) [Applications of electricity: light bulb, defibrillator, robotic arm, solar panels.] "Electricity and Magnetism: Measuring and using electricity" (16:35) [Informative, but older.] EtF Project 4 Quick Tip Video: "Hula Hoop Electricity" (2:09) EtF Project 4 Quick Tip Video: "Ammeter & Voltmeter" (2:23) EtF Project 4 Quick Tip Video: "Series & Parallel Circuits" (1:40) "Electricity's Power: Part 1" (18:50) [Linemen, blackouts, and the Hoover Dam] "Power Lines & Transformers" (22:50) EtF Project 4 Quick Tip Video: "Electrical Power" (1:45) "Electricity: How it Works" (24:04) [Informative, but older.] "Energy from the Earth" (6:24) [Generators that run on steam or geothermal.] "Ecopolis: Powering the Future" (44:34) [Energy options for megacities of the future.] "Bill Nye: Energy" (55:56) "The true story of the internet: Bubble" (42:40) [Creators of Amazon and Ebay explain the development of the internet.] "Bill Nye: Communication" (55:56) [With shorter segments related to different forms of technology.] "Electronics and Television" (9:00) "Tune into TV" (6:50) EtF Project 4 Quick Tip Video: "Communication" (1:44) "Fiber Optics" (3:23) **Website**: EtF Electricity Flash Module Environmental Defense Fund http://www.edf.org/climate/remaking-energy US Dept. of Energy Solar Home Competition http://www.solardecathlon.gov/ Wind Energy Info www.kidwind.org Green Energy www.greenenergytv.com

Vocabulary	Tier three vocabulary: ammeter, conductor, current, electric circuit, insulator, multimeter, parallel circuit, power, resistance, series circuit, voltage, analog signal, decode, digital signal, encode, fiber optic, laser, receiver, transmitter, reflection, waves, radio waves, frequency, electromagnetic, infrared, satellite, alternating current (AC), direct current (DC), energy, efficiency, fuse, generator, grid, load, nonrenewable energy, renewable energy, source, transformer Tier two vocabulary: compare, constant, consist, placement, observe, perform, task, diameter, loss, input, output, terminal, appliance, restrict, increase, decrease, protect, compare, constant, consist, placement, observe, perform, task, diameter, loss, input, output, terminal, appliance, restrict, increase, decrease, protect, identical, advantage, optical, coded, signal, vary, deliver, destination, retrieval, pulse, transmit, replace, susceptible, interference, storage, component, core, industry, coherent, binary, represent, strike, behavior, limited, capacity, application, functioning