Grade, Subject/Course: Engineering Design / Honors (10-12)	
Unit: Introduction To Engineering Design	**__X__ Essential _____ Important _____ Compact**
Big Idea: The engineering design process can be applied to solve technological problems.	
STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.U Evaluate and define the purpose of a design. 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design.	**Pacing:** 2 weeks
Essential Questions: UEQ: What is engineering design? LEQ: What are several engineering disciplines currently offered within the engineering design field? LEQ: How are problems and opportunities identified when analyzing real-world situations? LEQ: What clarification and specifications are needed to frame a design brief? LEQ: How are research and investigations conducted to gather information for possible future reference in solving problems? LEQ: How are brainstorming and other techniques used to generate alternative solutions to problems? LEQ: How is the best solution to a problem chosen when evaluating several solutions on an attribute matrix? LEQ: Why do engineers use models or prototypes to test solutions to problems? LEQ: Why is it important for engineers to evaluate and analyze solutions to problems?	**Understandings:** Students will know that… ● Engineering uses math and science to design, build, and test machines, structures, and processes to solve problems. ● Technological problems can be solved by applying the engineering design process. ● Several engineering disciplines are offered within the field of engineering design. ● Design thinking is a mindset and approach to problem-solving and innovation anchored around human-centered design.

LEQ: What communication methods can you use when recording your test data results?	
Knowledge: Engineering Engineering Disciplines Engineering Design Process Design Thinking	**Do/Skills:** Students will be able to… ● Identify problem-solving strategies. ● Conduct technical research. ● Develop multiple solutions. ● Build models and prototypes. ● Test and evaluate prototypes. ● Analyze and modify original designs.
Vocabulary: Engineer, Engineering, Engineering Design, Model, Prototype, Attribute Matrix, Technical Research, Synopsis, Brainstorming	**Core Resources:** Schoology LMS
Common Assessment(s): 1. What Is Engineering Discussion Post 2. Engineering Disciplines Presentation 3. IDEO Shopping Cart: Deep Dive Worksheet 4. Design Thinking Activity: Improving Your School Presentation	**Supplemental Resources:** What Is Engineering? (National Science Foundation) What is Engineering? (What do Engineers do) | Explore Engineering Penn State College of Engineering What Is Engineering? (University of Bath) Deep Dive The Engineering Design Process: A Taco Party

Grade, Subject/Course: Engineering Design / Honors (10-12)	
Unit: Ship The Chip	**__X__ Essential _____ Important _____ Compact**
Big Idea: The engineering design challenge is to safely ship a chip through the USPS in a package without damaging the sample.	
STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems.	**Pacing:** 5 weeks

3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.P Apply a broad range of design skills to a design thinking process. 3.5.9-12.Q Implement and critique principles, elements, and factors of design. 3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants. 3.5.9-12.T (ETS) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 3.5.9-12.U Evaluate and define the purpose of a design. 3.5.9-12.W Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs. 3.5.9-12.X Implement the best possible solution to a design using an explicit process. 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process. 3.5.9-12.BB Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system. 3.5.9-12.DD Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. 3.5.9-12.OO Use project management tools, strategies, and processes in planning, organizing, and controlling work. 3.5.9-12.PP Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting	

considerations before the entire system is developed and to aid in design decision making. 3.5.9-12.QQ Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.	
Essential Questions: UEQ: How is the engineering design process used to engineer a package that will safely ship a chip through the USPS without damaging the sample? LEQ: What are the functions of a package? LEQ: What are some of the different types of packages for food products? LEQ: What are some of the different materials used for packages and cushioning items from breakage? LEQ: How are packages constructed and what tools are used to manufacture a package? LEQ: How much does shipping different packages through the US Postal Service cost and the shipping requirements? LEQ: What is the size, weight, shape, and breakage strength of a Pringles chip? LEQ: How are math and science concepts used to design and construct a package to ship a chip through the USPS?	**Understandings:** Students will know that… ● The primary function of packaging is to keep the product safe from damage, breakage, spoilage, leakage, and pilferage. ● Different types of packages are used to protect food products from damage, breakage, spoilage, leakage, and pilferage. ● Various packaging materials and cushioning items are being used to manufacture packages that are more environmentally sustainable. ● Specific tools and techniques are used to construct and manufacture a package. ● Shipping costs and requirements differ depending on the package size, weight, and types of items.
Knowledge: Problem & Design Brief Research & Gathering Information ● Functions of A Package ● Types of Packages ● Materials Used In Packaging and Cushioning ● Manufacturing and Construction of A Package ● Postal Shipping Costs and Requirements ● Pringles Chip Characteristics Developing Ideas & Solutions Choosing The Best Solution Construction Drawings Building Prototypes Testing & Data Collection Evaluation & Analysis	**Do/Skills:** Students will be able to… ● Design a package by selecting materials that will protect a chip from breaking during shipping. ● Use manufacturing tools and techniques to construct a package prototype to protect a chip from being damaged during shipping. ● Test packaging models and make predictions about the overall performance of their final package design. ● Calculate the proper volume and mass of a package to meet USPS shipping requirements and specifications. ● Use the proper equipment to collect, interpret, and analyze the effectiveness of the package design.
Vocabulary: Crisps, Hyperbolic Paraboloid, Environmentally Sustainable, Cushioning, Corrugated Cardboard, USPS, Volume, Mass	**Core Resources:** Schoology LMS Autodesk AutoCAD

Common Assessment(s):	**Supplemental Resources:**
1. Ship The Chip Package Design Project 2. Ship The Chip Package Design Portfolio 3. Ship The Chip Package Design Pitch (Oral Presentation)	Everything Pops With Pringles Kellogg's Packaging Engineer Ship The Chip WebQuest

Grade, Subject/Course: Engineering Design / Honors (10-12)	
Unit: Creative Crane	**__X__ Essential _____ Important _____ Compact**
Big Idea: The engineering design challenge is to have a working crane capable of lifting the extreme weight of the new beams and trusses used to build high-rise structures.	
STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.P Apply a broad range of design skills to a design thinking process. 3.5.9-12.Q Implement and critique principles, elements, and factors of design. 3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants.	**Pacing:** 6 weeks

3.5.9-12.T (ETS) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 3.5.9-12.U Evaluate and define the purpose of a design. 3.5.9-12.W Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs. 3.5.9-12.X Implement the best possible solution to a design using an explicit process. 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. 3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process. 3.5.9-12.BB Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system. 3.5.9-12.DD Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. 3.5.9-12.OO Use project management tools, strategies, and processes in planning, organizing, and controlling work. 3.5.9-12.PP Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making. 3.5.9-12.QQ Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.	
<u>Essential Questions</u>: UEQ: How is the engineering design process used to engineer a working crane capable of lifting the extreme weight of the new beams and trusses used to build high-rise structures? LEQ: What are the parts of a crane and their different functions? LEQ: What are the different forces and loads that act upon structures? LEQ: How are geometric shapes strengthened to make them more structurally stable? LEQ: What is a block-and-tackle and how are pulleys arranged to increase or decrease mechanical advantage? LEQ: How are gear ratios calculated to determine the relationship between rotational speed and torque?	**<u>Understandings</u>:** Students will know that… ● The parts of a tower crane have different functions. ● External and internal forces and loads acting on structures include compression, tension, shear, bending, torsion, and fatigue. ● Geometric shapes can be strengthened to make them more structurally stable. ● Pulley arrangements can increase or decrease the mechanical advantage in a block-and-tackle system. ● Geartrains can increase or decrease rotational speed or torque in a gearbox. ● Glues and adhesives vary based on holding strength for different materials. ● Counterweights are used to stabilize cranes to avoid rotational overturning.

LEQ: Which glues or adhesives have the best holding strength for balsawood? LEQ: How are cranes stabilized to avoid rotational overturning using counterweights?	
Knowledge: Problem & Design Brief Research & Gathering Information ● Types of Cranes & Parts of a Crane ● Forces & Loads that Act on Structures ● Geometric Shapes & Structural Design ● Pulleys: Mechanical Advantage (Block & Tackle) ● Gears: Gear Ratios (Speed vs. Torque) ● Glue & Adhesive Types (Holding Strength) ● Crane Stability: Rotational Overturning & Counterweight Developing Ideas & Solutions Choosing The Best Solution Construction Drawings Building Prototypes Testing & Data Collection Evaluation & Analysis	**Do/Skills:** Students will be able to… ● Identify the parts of a crane and explain their functions. ● Predict and determine forces and loads acting on structures and structural members. ● Test and collect data on different structural shape strengths, glues and adhesives, and construction materials. ● Design and calculate the best mechanical advantage of a block-and-tackle pulley system for lifting heavy weights. ● Design and calculate the best gear ratio of speed and torque in a geartrain for lifting heavy weights. ● Predict and adjust the counterweight of a crane to avoid rotational overturning. ● Build a working crane prototype capable of lifting the extreme weight of the new beams and trusses used to build high-rise structures.
Vocabulary: Tower Crane, Load, Compression, Tension, Shear, Torsion, Bending, Buckling, Beam, Truss, Joints, Lateral Bracing, Fixed Pulley, Movable Pulley, Mechanical Advantage, Block & Tackle, Gear Ratio, Speed, Velocity, Torque, Force, Geartrain, Gearbox, Holding Strength, Adhesive, Crane Stability, Rotational Overturning, Counterweight, Moment	**Core Resources:** Schoology LMS Autodesk AutoCAD
Common Assessment(s): 1. Creative Crane Design Project 2. Creative Crane Design Portfolio 3. Creative Crane Design Pitch (Oral Presentation)	**Supplemental Resources:** Creative Crane Lesson Creative Crane WebQuest

Grade, Subject/Course: Engineering Design / Honors (10-12)	
Unit: Team America Rocketry Challenge	**__X__ Essential _____ Important _____ Compact**
Big Idea: The engineering design challenge is to carry an exceedingly fragile payload for as long as possible and recover the payload to the ground without damage.	
STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.I (ETS) Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. 3.5.9-12.N Analyze and use relevant and appropriate design thinking processes to solve technological and engineering problems. 3.5.9-12.O Apply appropriate design thinking processes to diagnose, adjust, and repair systems to ensure precise, safe, and proper functionality. 3.5.9-12.P Apply a broad range of design skills to a design thinking process. 3.5.9-12.Q Implement and critique principles, elements, and factors of design. 3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants. 3.5.9-12.T (ETS) Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. 3.5.9-12.U Evaluate and define the purpose of a design. 3.5.9-12.W Optimize a design by addressing desired qualities within criteria and constraints while considering trade-offs. 3.5.9-12.X Implement the best possible solution to a design using an explicit process. 3.5.9-12.Y (ETS) Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	**Pacing:** 5 weeks

3.5.9-12.Z Recognize and explain how their community and the world around them informs technological development and engineering design. 3.5.9-12.AA Safely apply an appropriate range of making skills to a design thinking process. 3.5.9-12.BB Assess how similarities and differences among scientific, technological, engineering, and mathematical knowledge and skills contributed to the design of a product or system. 3.5.9-12.DD Develop a plan that incorporates knowledge from science, mathematics, and other disciplines to design or improve a technological product or system. 3.5.9-12.OO Use project management tools, strategies, and processes in planning, organizing, and controlling work. 3.5.9-12.PP Demonstrate the use of conceptual, graphical, virtual, mathematical, and physical modeling to identify conflicting considerations before the entire system is developed and to aid in design decision making. 3.5.9-12.QQ Implement quality control as a planned process to ensure that a product, service, or system meets established criteria.	
Essential Questions: UEQ: How is the engineering design process used to engineer a model rocket that will carry an exceedingly fragile payload (one raw egg) for as long a time as possible and recover the payload to the ground without damage? LEQ: What are the parts of a payload model rocket and their distinct functions? LEQ: What are Newton's Laws of Motion and how do they relate to the flight of a model rocket? LEQ: How does aerodynamics and static margin affect the stability of a model rocket? LEQ: What are the various construction materials, tools, and techniques used to build model rockets safely? LEQ: How are math and science concepts used to design, construct, and fly a model rocket? LEQ: How does meteorology influence the flight of a model rocket? LEQ: What are the NAR rules and code regulations that must be adhered to safely design, build, and fly model rockets? LEQ: How are RockSim computer simulations used to make predictions and adjustments to ensure a sound design that meets the requirements of the TARC? LEQ: How is a parachute installed and used to recover the payload and booster sections of a payload model rocket?	**Understandings:** Students will know that… ● The parts of a payload model rocket have distinct functions. ● Newton's Laws of Motion govern the forces and loads acting on a model rocket during flight. ● Aerodynamics and static margin affect the stability of model rockets. ● Various construction materials, tools, and techniques are used to build model rockets safely. ● Math and science concepts are used to design, construct, and fly a model rocket. ● Meteorology influences the flight of a model rocket. ● NAR rules and code regulations must be adhered to safely design, build, and fly model rockets.

LEQ: What is the procedure for safely launching and recovering a model rocket?	
Knowledge: Problem & Design Brief Research & Gathering Information ● Types and Parts of a Payload Model Rocket ● Newton's Laws of Motion: Forces & Loads ● Aerodynamics and Rocket Stability ● Rocket Materials and Construction ● Recovery Systems ● Payload Cushioning & Lofting ● Rocket Launch Stages & Engines ● Meteorology Developing Ideas & Solutions Choosing The Best Solution Construction Drawings Building Prototypes Testing & Data Collection Evaluation & Analysis	**Do/Skills:** Students will be able to… ● Identify the parts of a payload model rocket and explain their functions. ● Design a payload model rocket using Rocksim. ● Run computer simulations of the rocket's flight to ensure sound design and that the design meets the requirements of the TARC. ● Determine and adjust model rocket stability. ● Predict and adjust the rocket altitude by adjusting the mass ● Predict and adjust the rocket flight times by adjusting the recovery system ● Predict and adjust the rocket altitude by using rocket motors with various Newtons of force. ● Calculate the proper size and dimensions of rocket parts and manufacture them to those specifications. ● Build an aerodynamically sound payload model rocket to the specifications of the design that withstands the stresses of multiple mid-power flights and is capable of protecting the egg. ● Properly install and use a parachute to recover the payload and booster sections of a payload model rocket. ● Analyze preliminary flights to redesign and improve their model rocket as needed. ● Use the proper equipment to collect, interpret, and predict the effects of atmospheric conditions on rocket flight. ● Safely launch a model rocket and recover it.
Vocabulary: Payload Model Rocket, Nose Cone, Body Tube, Engine Tube, Engine Block, Launch Lug, Parachute, Shock Chord, Fins, Centering Rings, Engine Hook, Newton's Laws of Motion, Aerodynamics, Coefficient of Drag, Forces, Loads, Center of Gravity, Center of Pressure, Static Margin, National Association of Rocketry (NAR), Model Rocket Safety Code	**Core Resources:** Schoology LMS RockSim Software
Common Assessment(s): 1. TARC Model Rocket Design Project 2. TARC Model Rocket Design Portfolio 3. TARC Model Rocket Design Pitch (Oral Presentation)	**Supplemental Resources:** Team America Rocketry Challenge National Association of Rocketry Team America Rocketry Challenge WebQuest

Grade, Subject/Course: Engineering Design / Honors (10-12)	
Unit: Honors Project	**__X__ Essential _____ Important _____ Compact**
Big Idea: Many engineering inventions and innovations have greatly influenced society as a way to solve complex real-world problems.	
STEELS/Tech and Engineering Strand: 3.5.9-12.A Use various approaches to communicate processes and procedures for using, maintaining, and assessing technological products and systems. 3.5.9-12.F Evaluate a technological innovation that arose from a specific society's unique need or want. 3.5.9-12.G Evaluate a technological innovation that was met with societal resistance impacting its development. 3.5.9-12.S Conduct research to inform intentional inventions and innovations that address specific needs and wants. 3.5.9-12.U Evaluate and define the purpose of a design. 3.5.9-12.GG Evaluate how technology and engineering have been powerful forces in reshaping the social, cultural, political, and economic landscapes throughout history. 3.5.9-12.KK Relate how technological and engineering developments have been evolutionary, often the result of a series of refinements to basic inventions or technological knowledge.	**Pacing:** Bi-weekly
Essential Questions: UEQ: Which engineering inventions and innovations have greatly influenced society as a way to solve complex real-world problems? LEQ: How have engineering inventions and innovations positively and negatively influenced society as a way to solve complex real-world problems?	**Understandings:** Students will know that… ● Engineering inventions and innovations have greatly influenced society as a way to solve complex real-world problems. ● Engineering inventions and innovations positively and negatively impact society when solving real-world problems.
Knowledge: Engineering Inventions & Innovations Societal Impacts	**Do/Skills:** Students will be able to… ● Research and present information about a real-world problem, the solution to the problem, how engineering inventions and innovations work, and the positive and negative impacts on society.

Vocabulary: Invention, Innovation, Trade-offs, Impacts	**Core Resources:** Schoology LMS Wix
Common Assessment(s): 1. Blog (8 Posts)	**Supplemental Resources:**