Summit Public Schools
Summit, New Jersey
Grade Level 8 Content Area: Technical Education
Course Title: Innovative Design Challenge
Length of Course: 9 weeks
Revised by William Rohrbach 2018
Curriculum

Course Description:
Innovative Design Challenge is an 8th grade STEM course designed to build upon the student's technical knowledge gained in the Intro to Technology/Technical Education course taken in grades 6 or 7, which is generally a prerequisite for entry into this elective course. Students in this advanced class demonstrate the application of the **Engineering Design Process (EDP)** to the solution of practical real-world problems. This project-based curriculum focuses on the use of the 21st Century Skills of collaboration, creativity, critical thinking and communication to engineer solutions to a series of problems. Students will follow the 8 step EDP from identification of the problem, through solution brainstorming, design, prototyping and testing. The student-centered course focuses on a series of projects that afford students exposure to a series of problems that create opportunities for higher order learning such as analysis, evaluation and creation, while also advancing their "maker skills". During the design, engineering and development of their final project, students will apply their knowledge of science and mathematics, engineering drawing to develop a functional and testable product, all while maintaining a professional engineering record (journal) from concept to completion.

The specific units are:

- The Nature of Technology – Man and Society
- The Engineering Design Process
- Engineering the Solution Parts 1 & 2

UNIT ONE: The Nature of Technology, Invention & Innovation (2 Weeks)

8.1.8.A. - Technology Operations and Concepts **8.1.8.B-Creativity and Innovation** **8.1.8.C - Communication and Collaboration** **8.1.8.D Technology, - Digital Citizenship** **8.1.8.E - Research and Information Fluency** **8.1.8.F – Critical Thinking** **8.2.8.A – Nature of Technology: Creativity and Innovation** **8.2.8.B – Technology and Society** **8.2.8.C- Design** **8.2.8.D – Abilities for a Technological World** **8.2.8.E- Computational Thinking** **MS-PS-1: Matter and its Interactions** **MS-PS-2 Motion & Stability: Forces & Interactions** **MS-ETS1 - Engineering Design** **NJSLS Math 8.4, 8.5, 8.6**	
Big Ideas: *Course Objectives / Content Statement(s)* Understanding the history of technology provides a basis for understanding how the world around us has evolved. The rate of change of technology and the pace of invention and innovation is increasing exponentially. Most inventions made for the good of mankind can still have a devastating impact on society if used improperly.	
Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
1. Has technology only been used for the good of mankind? 2. If technology is constantly changing, how can we know what skills to learn? 3. What are the ways technology has changed the lives of mankind both for the good and the bad? 4. What is digital citizenship and how does it relate to a middle school student	Students will understand that… • Technology intended for the good of mankind can be used for harmful purposes. • Inventors, inventions, and their innovations play an important role in 21st Century learning and problem-solving. • New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.

5. What current and/or anticipated real-world problems do we have to consider where innovation and invention will play a key role	• Technologies, no matter how useful, have intended and unintended consequences that can pose ethical, economic, political, or cultural or environmental issues. • There are guidelines to be followed that ensure safety while working with tools, machines, and materials.
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Technology Standard 8.1.8.A Technology, Educational Technology: Technology Operations and Concepts Students demonstrate a sound understanding of technology concepts, systems and operations **Technology Standard 8.1.8.B Technology, Educational Technology: Creativity and Innovation** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology. **Technology Standard 8.1.8.C Technology, Educational Technology: Communication and collaboration** Students use digital media and environments to communicate and work collaboratively. **Technology Standard 8.1.8.D Technology, Educational Technology: Digital Citizenship** Students advocate and practice safe, legal and responsible use of information and technology. **Technology Standard 8.1.8.E Technology, Educational Technology: Research and Information Fluency** Students use digital tools to gather, evaluate and use information.	Instructional Focus: • Understand the core concepts of technology • Development of a new product or design • Familiarize students with important inventors, inventions and innovations • Effects of technology of society, economy, culture and politics Sample Assessments: • Design Challenge: Working in project teams students develop a solution to a real-world problem; texting while driving. Process includes a problem statement, a design brief, brainstorm, prototype development, testing and redesign. • Students prepare a multimedia presentation of the solution for presentation to the class. • Engineering Journal Review • Collaborative Group Response (Describe your experience, share new ideas, etc.) • Brainstorming session observation. Instructional Strategies: • Reading Comprehension Activity • Students watch the video “Technology and Society” • Whole Group Discussion - positive & negative results of innovation.

Technology Standard 8.1.8.F Technology, Educational Technology: Critical Thinking Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions. **Technology Standard 8.2.8.A Technology, Education, Engineering and Design: Nature of Technology: Creativity and Innovation** Technology products and systems impact every aspect of the world in which they live. **Technology Standard 8.2.8.B Technology, Educational Technology, Technology and Society:** Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in a global society. **Technology Standard 8.2.8.C Technology, Education, Engineering and Design: Critical Thinking, Problem Solving, and Decision-Making** The design process is a systematic approach to solving problems. **Technology Standard 8.2.8.D Technology, Educational Technology: Abilities for a Technological World** The designed world is the product of a design process that provides the means to convert resources into products and systems **Technology Standard 8.2.8.E Technology, Education, Engineering and Design: Communication and Collaboration** Digital tools facilitate local and global communication and collaboration in designing products and systems. **NGSS Standard MS-PS2-1** Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.	Collaboration Activity: • Students will brainstorm the most important invention of their lifetime and share finding with class. (typically, smart phones are #1) • Students watch public safety video on the impact of texting while driving and participate in a whole group discussion. • Journal Entries: constructed responses will be written in students' Engineering Design notebooks Interdisciplinary Connections • Math - Measurements, sketches of potential designs with measurements • Engineering - Application of Design Process, create a design brief, prototype development, testing and redesign • Science concepts - Create a list of procedures, follow constraints • Science - Review of Newton's Laws of Motion, calculation of force Technology Integration • Exploration: students observe and discuss the positive and negative impacts of technology and consider the associated ethical, societal, economic, political and cultural issues • Research the impacts of technology and the issues that surface after the technology has been developed Global Perspectives • Engineers and scientists in different countries collaborate to solve problems • Students can work in groups to research and gather information about three controversial technologies that have been featured "in the news" • There are implications of all inventions; even positive intentions can have negative implications; their use must be monitored through the

NGSS Standard 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 its mass. **NGSS Standard MS - ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, considering the relevant scientific principles and potential impacts on people and natural environment that may limit possible solutions. **NGSS Standard MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **NGSS Standard 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. **NJSLS Math Practice 8.4 - Model with Math** Identify important quantities in practical situations and map their relationships **NJSLS Math Practice 8.5 – Use Tools Strategically** Use tools to solve a mathematical problem. Tools may include pencils, paper, rulers, protractor, calculator, spread sheet etc. **NJSLS Math Practice 8.6 Attend to Precision** Use clear definitions in discussion with others and in reasoning. Use care in specifying units of measure.	• When invention and innovation are present in a society, society itself must adapt to provide a venue for them. Culturally Responsive Teaching • Different cultures are likely to have different views and perspectives about the value of technology to a society.

The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.	**21st Century Skills:** Creativity and Innovation Critical Thinking and Problem Solving Communication and Collaboration Information Literacy Media Literacy Life and Career Skills **21st Century Themes:** Financial, Economic, Business, and Entrepreneurial Literacy Civic Literacy Health Literacy S.T.E.A.M. (Science, Technology, Engineering, Arts, Mathematics

UNIT TWO: Engineering Design Process – Project Bridgebuilding (2 Weeks)

8.1.8.A. - Technology Operations and Concepts **8.1.8.B.1 -Creativity and Innovation** **8.1.8.C. - Communication and Collaboration** **8.1.8.D Technology, - Digital Citizenship** **8.1.8.E. - Research and Information Fluency** **8.1.8.F – Critical Thinking** **8.2.8.A – Nature of Technology: Creativity and Innovation** **8.2.8.B – Technology and Society** **8.2.8.C.- Design** **8.2.8.D – Abilities for a Technological World** **8.2.8.E- Computational Thinking** **MS-PS-2 Motion & Stability: Forces & Interactions** **MS-ETS1 - Engineering Design** **NJSLS Math 8.G** **NJSLS Math 8.4, 8.5, 8.6**
Big Ideas: *Course Objectives / Content Statement(s)* The engineering design process is a series of steps that guides engineering teams as they solve problems. The design process is iterative, meaning that teams may need to repeat steps as needed, making improvements along the way as they learn from failure.

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
1. What are the steps of the Engineering Design Process 2. Why do engineering teams follow a process 3.How does diversity impact the efficacy of the team 3. How do criteria and constraints impact a design? 4 How can we apply the Engineering design process to design and prototype a model truss bridge.	Students will understand that… • The Engineering Design Process is an iterative systematic problem-solving strategy, with criteria and constraints. • How the design process is used to solve real-world problems • There are no bad ideas • The importance of sketches, engineering drawings and engineering journals

	• Technological advances have flaws and there is no perfect design • Failure is an essential part of the process
Areas of Focus: Proficiencies (Cumulative Progress Indicators)	**Examples, Outcomes, Assessments**
Technology Standard 8.1.8.A Technology, Educational Technology: Technology Operations and Concepts Students demonstrate a sound understanding of technology concepts, systems and operations **Technology Standard 8.1.8.B Technology, Educational Technology: Creativity and Innovation** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology. **Technology Standard 8.1.8.C Technology, Educational Technology: Communication and collaboration** Students use digital media and environments to communicate and work collaboratively. **Technology Standard 8.1.8.D Technology, Educational Technology: Digital Citizenship** Students advocate and practice safe, legal and responsible use of information and technology. **Technology Standard 8.1.8.E Technology, Educational Technology: Research and Information Fluency** Students use digital tools to gather, evaluate and use information. **Technology Standard 8.1.8.F Technology, Educational Technology: Critical Thinking** Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions.	Instructional Focus: • Understand the core concepts of technology and technology systems • Work productively in collaborative groups • Brainstorming techniques • Identify criteria and constraints of the design process • Review of engineering drawing techniques and standards • Draw orthographic and isometric representations of an object to illustrate a design concept • Requirements for a design include both criteria and constraints • Students watch the Nightline™ deep dive video on the design process used at IDEO • Identify and describe the major steps in the Engineering Process • Students watch the video “Bridges and Forces” Sample Assessments: • Engineering Design Process Quiz • Truss Bridge Building Project Assessed in accordance with the Truss Bridge grading rubric. Instructional Strategies: • Review engineering drawing practices • Gain fluency with the engineering design process • Demonstrate the use the engineering design process Demonstrate and practice brainstorming techniques

Technology Standard 8.2.8.A Technology, Education, Engineering and Design: Nature of Technology: Creativity and Innovation Technology products and systems impact every aspect of the world in which they live. **Technology Standard 8.2.8.B Technology, Educational Technology, Technology and Society:** Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in a global society. **Technology Standard 8.2.8.C Technology, Education, Engineering and Design: Critical Thinking, Problem Solving, and Decision-Making** The design process is a systematic approach to solving problems. **Technology Standard 8.2.8.D Technology, Educational Technology: Abilities for a Technological World** The designed world is the product of a design process that provides the means to convert resources into products and systems **Technology Standard 8.2.8.E Technology, Education, Engineering and Design: Communication and Collaboration** Digital tools facilitate local and global communication and collaboration in designing products and systems. **NGSS Standard MS - ETS1-1** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, considering the relevant scientific principles and potential impacts on people and natural environment that may limit possible solutions. **NGSS Standard MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	• Students watch the video "Bridges and Forces" • Explore bridge types and the forces inherent to different bridge types • Explore the specific forces impacting the truss bridge • Explore methods for maximizing truss bridge strength • Demonstrations of hand tools and machines • Project teams build truss bridges from one pizza box and 4 hot glue sticks • Test bridge models until failure • Analyze failure and discuss compensating strategies • Research: key words and concepts associated with efficient designs (force, compression, tension, reinforcing, lamination, structural profiles Interdisciplinary Connections • Engineering - sketches, concept drawings, scale drawings, prototype model, data and testing • Math – measurements, center of a rectangle • Science – free body diagrams of the compression and tensile forces • Science - Newton's Laws relative to force and motion • Art - Aesthetically appealing design of a truss bridge Technology Integration • Chromebooks for research on Bridges and materials • Google Drive for collaboration, brainstorming of ideas, analysis of data, maintaining log and portfolio, communication of results Global Perspectives

NGSS Standard 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. **NJSLS Math Practice 8.4 - Model with Math** Identify important quantities in practical situations and map their relationships **NJSLS Math Practice 8.5 – Use Tools Strategically** Use tools to solve a mathematical problem. Tools may include pencils, paper, rulers, protractor, calculator, spread sheet etc. **NJSLS Math Practice 8.6 Attend to Precision** Use clear definitions in discussion with others and in reasoning. Use care in specifying units of measure.	• Architects and engineers use the same drawing methods to convey their ideas to others • Scientists and engineers use the same design process globally • There is a universal language of design and measurement using the metric system of measurement • Drawings and renderings of an innovation and invention must be drawn accurately to scale and be precise to allow for success in the manufacturing process worldwide. Culturally Responsive Teaching • Engineering drawings may be dimensioned using a different standard (metric) by other cultures.
The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.	21st Century Skills: Creativity and Innovation Critical Thinking and Problem Solving Communication and Collaboration Information Literacy Media Literacy Life and Career Skills 21st Century Themes (as applies to content area): Financial, Economic, Business, and Entrepreneurial Literacy Civic Literacy Health Literacy S.T.E.A.M. (Science, Technology, Engineering, Arts, Mathematics

UNIT Three: Engineering the Solution (Part #1) (2 Weeks)

8.1.8.A. - Technology Operations and Concepts **8.1.8.C. - Communication and Collaboration** **8.1.8.D Technology, - Digital Citizenship** **8.1.8.E. - Research and Information Fluency** **8.1.8.F – Critical Thinking** **8.2.8.A – Nature of Technology: Creativity and Innovation** **8.2.8.C.- Design** **8.2.8.D – Abilities for a Technological World** **8.2.8.E- Computational Thinking** **MS-ETS1 - Engineering Design** **NJSLS Math 8.G** **NJSLS Math 8.4, 8.5, 8.6**	
Big Ideas: *Course Objectives / Content Statement(s)* Engineering Drawings are the international language of the engineer/designer. Accurately drawn and dimensioned drawings, drawn to convention, allow for the communication and subsequent manufacture of a design globally.	
Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
1. Why should every design begin with concept sketches and basic drawings 2. What do we mean by drawing convention 3. What types of information are communicated through drawing technology? 4.How has CAD impacted the design process	Students will understand that… • Creativity and technology are important to inventions and innovations • Innovation is the process of modifying an existing product and/or system. • Invention is the process of taking ideas and developing new products, processes or systems. • Creatively is crucial to the success of any product or service • Accurate drawings and sketches can communicate your design ideas globally • The importance of dimensions in modeling

Areas of Focus: Proficiencies (Cumulative Progress Indicators)	Examples, Outcomes, Assessments
Technology Standard 8.1.8.A Technology, Educational Technology: Technology Operations and Concepts Students demonstrate a sound understanding of technology concepts, systems and operations **Technology Standard 8.1.8.C Technology, Educational Technology: Communication and collaboration** Students use digital media and environments to communicate and work collaboratively. **Technology Standard 8.1.8.D Technology, Educational Technology: Digital Citizenship** Students advocate and practice safe, legal and responsible use of information and technology. **Technology Standard 8.1.8.E Technology, Educational Technology: Research and Information Fluency** Students use digital tools to gather, evaluate and use information. **Technology Standard 8.1.8.F Technology, Educational Technology: Critical Thinking** Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions. **Technology Standard 8.2.8.A Technology, Education, Engineering and Design: Nature of Technology: Creativity and Innovation** Technology products and systems impact every aspect of the world in which they live.	Instructional Focus: • Work independently to develop a unique individual design • Identify criteria and constraints of the design process • Requirements for a design are made up of criteria and constraints • Application of the major steps in the Engineering Process • Create a dimensionally accurate (scale) two or three view drawing. Sample Assessments: • Final Challenge: Students will develop a personal lighting system (lamp) that is properly wired and functional **or** a model CO2 powered dragster that can be tested by racing in pairs. • Final Drawings (orthographic) are created using the pencil, ruler, drawing method and must include a minimum of two views, proper dimensions, and a title block. • Students create a "Bill of Materials" for their design. • Assessment using the Technical Drawing Rubric Instructional Strategies: • Review of conventional engineering methods: Orthographic Projection and Isometric • Development of Materials List • Practice drawing in Orthographic Projection • View the Tinkercad ™ Tutorial • Draw and create an object using Tinkercad™ and a 3D printer • Assessment using the Technical Drawing Rubric

Technology Standard 8.2.8.C Technology, Education, Engineering and Design: Critical Thinking, Problem Solving, and Decision-Making The design process is a systematic approach to solving problems. **Technology Standard 8.2.8.D Technology, Educational Technology: Abilities for a Technological World** The designed world is the product of a design process that provides the means to convert resources into products and systems **Technology Standard 8.2.8.E Technology, Education, Engineering and Design: Communication and Collaboration** Digital tools facilitate local and global communication and collaboration in designing products and systems. **NGSS Standard MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **NGSS Standard 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. **NJSLS Math Practice 8.4 - Model with Math** Identify important quantities in practical situations and map their relationships **NJSLS Math Practice 8.5 – Use Tools Strategically** Use tools to solve a mathematical problem. Tools may include pencils, paper, rulers, protractor, calculator, spread sheet etc.	Interdisciplinary Connections • Mathematics - measurement of all requirements and constraints (using Metric measurement) • Mathematics - reading and developing scale drawings • Art - Drawing Methods (see above) • Art - Exploration of Design • Language Arts - review of propaganda techniques included in product pitches and advertisements • Engineering - Iterative process of redesign to increase accuracy and efficiency. Technology Integration • Chromebooks for research on prototypes. • Google Drive for collaboration, brainstorming of ideas, analysis of data, maintaining log and portfolio, communication of results • Tinkercad™ and 3D printing. Global Perspectives • Models and drawings of conceptual innovations and inventions must be clear in objective as it is often the first step to engineering as projects need capital for funding. • Ideas for innovations and inventions must be thought of from a global and cultural perspective before manufacture (Various cultures hold different beliefs and may view things differently) • There is a universal language of design and measurement using the metric system of measurement • Drawings and renderings of an innovation and invention must be drawn accurately to scale and be precise to allow for success in the manufacturing process.

NJSLS Math Practice 8.6 Attend to Precision Use clear definitions in discussion with others and in reasoning. Use care in specifying units of measure. The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.	Culturally Responsive Teaching • Engineering drawings may be dimensioned using a different standard (metric) by other cultures. 21st Century Skills: Creativity and Innovation Critical Thinking and Problem Solving Communication and Collaboration Information Literacy Media Literacy Life and Career Skills 21st Century Themes (as applies to content area): Financial, Economic, Business, and Entrepreneurial Literacy Civic Literacy Health Literacy S.T.E.A.M. (Science, Technology, Engineering, Arts, Mathematics)

UNIT THREE: **Engineering the Solution (Part #2) (3 Weeks)**

8.1.8.A. - Technology Operations and Concepts **8.1.8.B.1 -Creativity and Innovation** **8.1.8.C. - Communication and Collaboration** **8.1.8.D Technology, - Digital Citizenship** **8.1.8.E. - Research and Information Fluency** **8.1.8.F – Critical Thinking** **8.2.8.A – Nature of Technology: Creativity and Innovation** **8.2.8.B – Technology and Society** **8.2.8.C.- Design** **8.2.8.D – Abilities for a Technological World** **8.2.8.E- Computational Thinking** **MS-PS-2 Motion & Stability: Forces & Interactions** **MS-ETS1 - Engineering Design** **NJSLS Math 8.G** **NJSLS Math 8.4, 8.5, 8.6**
Big Ideas: *Course Objectives / Content Statement(s)* Invention and Innovation are driven by human needs and wants and are influenced by the core concepts of technology: systems, resources, requirements, optimization and tradeoffs, processes, and controls. These concepts are the cornerstone of creative design.

Essential Questions *What provocative questions will foster inquiry, understanding, and transfer of learning?*	**Enduring Understandings** *What will students understand about the big ideas?*
1. How are all the parts of a system interdependent and how can the malfunction of one affect the function and quality of the system as a whole? 2. What are the benefits of prototyping and why is it essential to the design process? 3. How does a team troubleshoot, diagnose, repair or modify a system or designed product to optimize performance? 4.What is electricity and what do we mean by difference of potential? What are the four forces in aerodynamics and what do we mean by equilibrium?	Students will understand that… • The relationship between invention and innovation are interrelated to the core concepts of design. • An electrical circuit requires a source of power as well as a source of ground in order to permit the flow of electrons. • The forces that make flight possible are in play on race cars as well as the family car. • The Testing element of the design process provides valuable pre-production performance data.

Areas of Focus: Proficiencies (Cumulative Progress Indicators)	Examples, Outcomes, Assessments
Technology Standard 8.1.8.A Technology, Educational Technology: Technology Operations and Concepts Students demonstrate a sound understanding of technology concepts, systems and operations **Technology Standard 8.1.8.B Technology, Educational Technology: Creativity and Innovation** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology. **Technology Standard 8.1.8.C Technology, Educational Technology: Communication and collaboration** Students use digital media and environments to communicate and work collaboratively. **Technology Standard 8.1.8.D Technology, Educational Technology: Digital Citizenship** Students advocate and practice safe, legal and responsible use of information and technology. **Technology Standard 8.1.8.E Technology, Educational Technology: Research and Information Fluency** Students use digital tools to gather, evaluate and use information. **Technology Standard 8.1.8.F Technology, Educational Technology: Critical Thinking** Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions.	Instructional Focus: • Application of the design process • Design Challenge: Completion of Model CO2 Dragster Design and timed Racing Competition or; Completion of a personal lighting system (lamp) including wiring and power testing • Evaluation of the design, determine accuracy and consistency • Hand and power woodworking tools and machines, shop safety and discipline Sample Assessments: • Model CO2 Dragster Design: Design build, finish, and race the fastest, most attractive looking and most aerodynamic prototype for a CO2 powered dragster **or**: Personal Lighting System Design: Design, build, finish wire and test the most attractive and functional personal lighting system (lamp) • Assessment according to either the CO2 car grading rubric or the Personal Lamp grading rubric. Instructional Strategies: • Compare/Contrast: The differences between a designer and engineer • Exploration of concepts such as: thrust, friction, drag, lift, gravity, traction, frontal area, turbulence, and airfoils **or**; • Electricity, circuit, positive source, ground, resistance, switch, polarity, electrons, difference in potential • Group Design Ideas using the Design requirements, which include: (total length, body height, minimum body width, axle distance, body mass, etc.) or Base dimensions, riser height, cap dimensions, wire bore, socket placement etc.

Technology Standard 8.2.8.A Technology, Education, Engineering and Design: Nature of Technology: Creativity and Innovation Technology products and systems impact every aspect of the world in which they live. **Technology Standard 8.2.8.B. Technology, Educational Technology, Technology and Society:** Knowledge and understanding of human, cultural and societal values are fundamental when designing technological systems and products in a global society. **Technology Standard 8.2.8.C Technology, Education, Engineering and Design: Critical Thinking, Problem Solving, and Decision-Making** The design process is a systematic approach to solving problems. **Technology Standard 8.2.8.D Technology, Educational Technology: Abilities for a Technological World** The designed world is the product of a design process that provides the means to convert resources into products and systems **Technology Standard 8.2.8.E Technology, Education, Engineering and Design: Communication and Collaboration** Digital tools facilitate local and global communication and collaboration in designing products and systems. **NGSS Standard 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 its mass.	• Benchmark Lessons (Whole Group): Aeronautics: students watch the videos "How Airplanes Fly" the "Aerodynamics of Racecars" and the "How's and why's of CO2 Dragsters" and discuss the application of the concepts to the car design or; The Video "How to Rewire a Lamp" • Students will watch the Videos "Band Saw Safety", How to use a Drill Press", "Spindle Sander Safety" and" Disc and Belt Sander Safety". • Students will complete the drawings, plans, develop the prototype, testing and final calculations • Interdisciplinary Connections • Mathematics - calculation of mass, average speed and terminal force. • Mathematics - measurement of all requirements and constraints Mathematics - reading and developing scale drawings • Art - Profile and top views (Perspective Drawing) • Art - Exploration of Design tips (smooth surface design and finish will reduce drag and increase efficiency) • Science - Understanding of Newton's Laws and the result of friction on a vehicle • Science - Understanding of aerodynamics as the branch of dynamics that deals with motion of air and other fluids over an object. • Science – Electricity, voltage, circuits, wires, switches etc. • Engineering - Design and construction of a vehicle to satisfy a specific need **or**; Design and build a lamp to satisfy a specific need. • Engineering - Iterative process of redesign to increase accuracy and efficiency, students can revisit

NGSS Standard MS - ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, considering the relevant scientific principles and potential impacts on people and natural environment that may limit possible solutions. **NGSS Standard MS-ETS1-2** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **NGSS Standard 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. **NJSLS Math Content 8.G.C.9** Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems **NJSLS Math Practice 8.4 - Model with Math** Identify important quantities in practical situations and map their relationships **NJSLS Math Practice 8.5 – Use Tools Strategically** Use tools to solve a mathematical problem. Tools may include pencils, paper, rulers, protractor, calculator, spread sheet etc. **NJSLS Math Practice 8.6 Attend to Precision** Use clear definitions in discussion with others and in reasoning. Use care in specifying units of measure.	Technology Integration • Chromebooks for research • Google Drive for collaboration among classmates for information sharing and brainstorming Global Perspectives • Architects and engineers use the same drawing methods to convey their ideas to others • Scientists and engineers all use the same design process all over the world • There is a universal language of design and measurement using the metric system of measurement • Drawings and renderings of an innovation and invention must be drawn accurately to scale and be precise to allow for success in the manufacturing process Culturally Responsive Teaching • Electrical voltages and frequencies and associated hardware differ significantly in other regions of the world.

The following skills and themes listed to the right should be reflected in the design of units and lessons for this course or content area.	21st Century Skills: Creativity and Innovation Critical Thinking and Problem Solving Communication and Collaboration Information Literacy Media Literacy Life and Career Skills 21st Century Themes (as applied to content area): Financial, Economic, Business, and Entrepreneurial Literacy Civic Literacy Health Literacy S.T.E.A.M. (Science, Technology, Engineering, Arts, Mathematics)